SCIENTIFIC AMERICAN SUPPLEMENT. No. 1490

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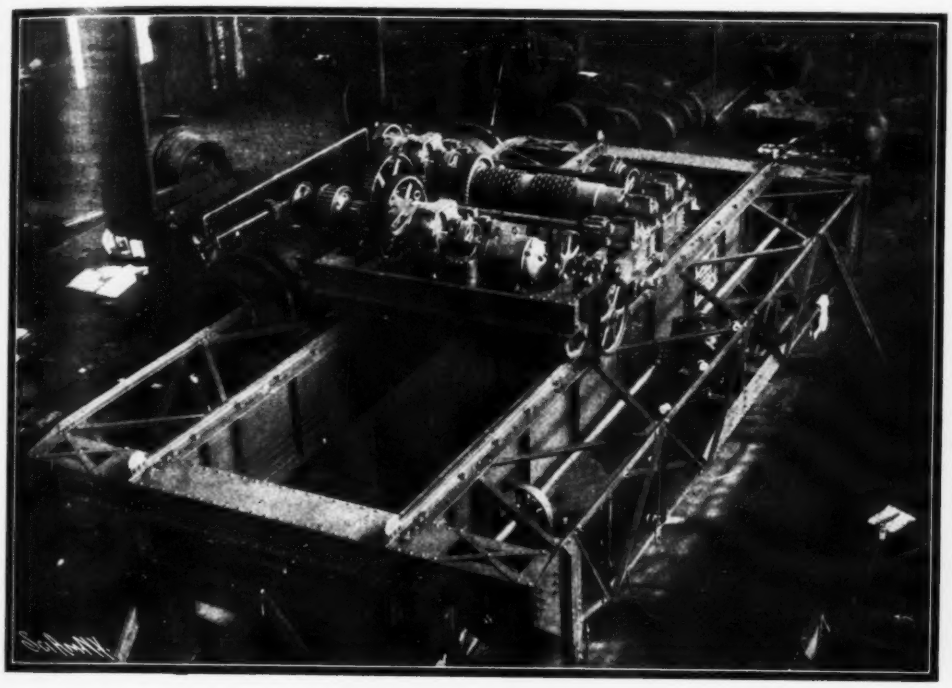
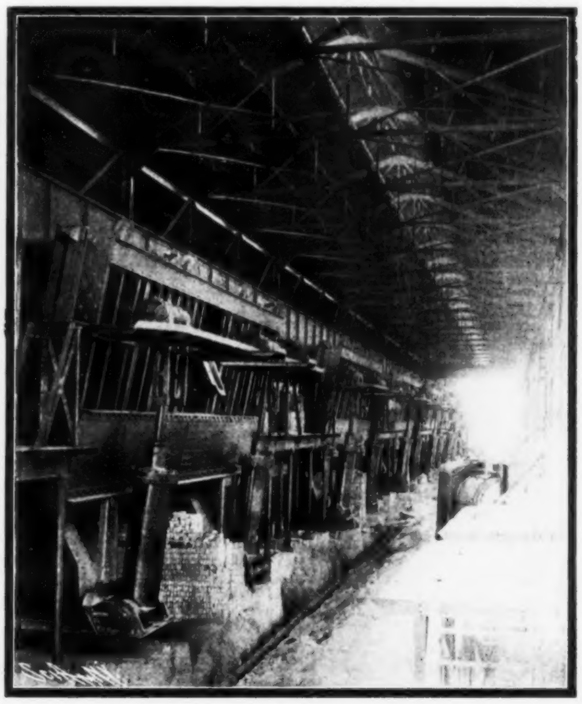
Scientific American, established 1845.
Scientific American Supplement, Vol. LVIII., No. 1490.

NEW YORK, JULY 23, 1904.

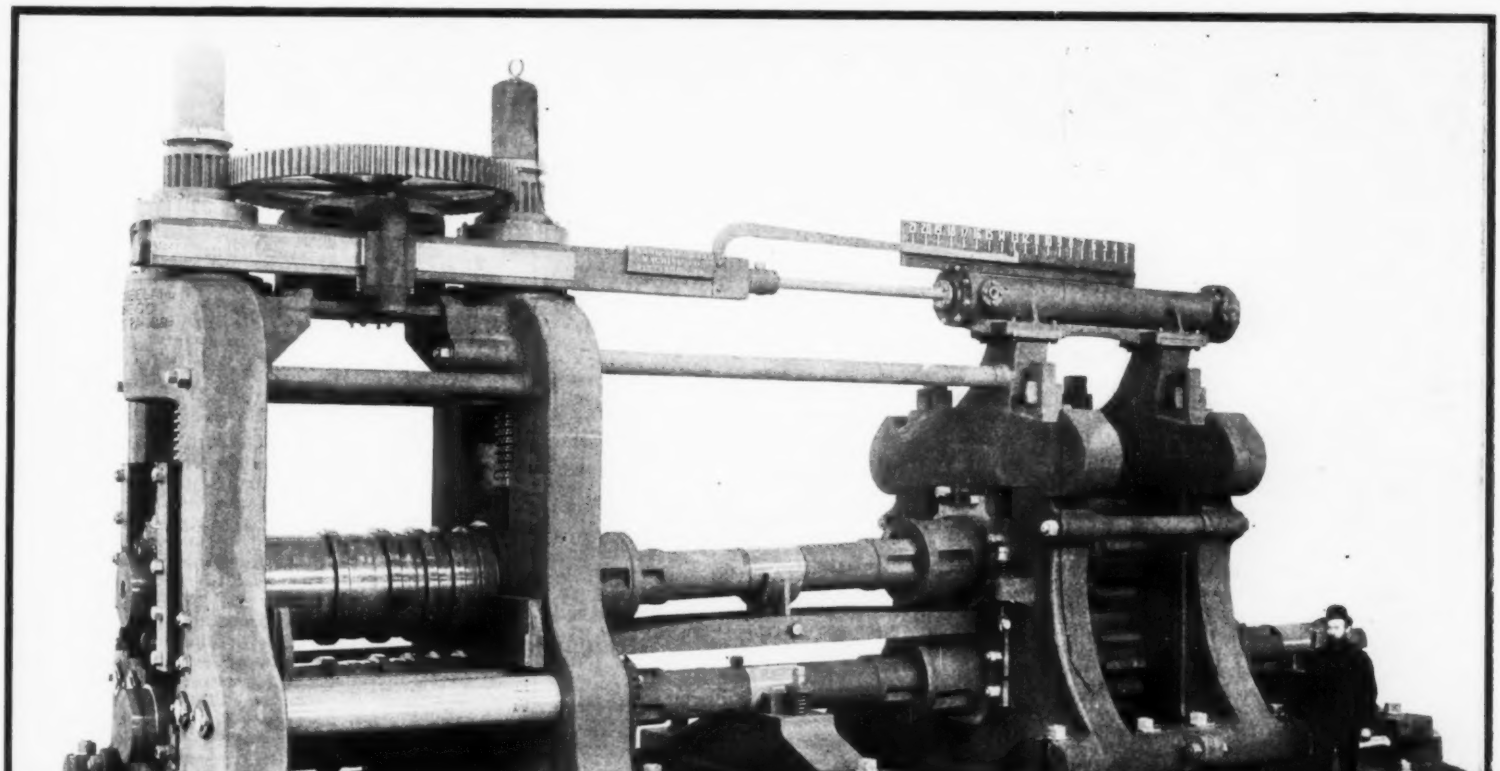
Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.



A CHARGING CRANE.



THE OPEN-HEARTH FURNACES.



THE 42-INCH ROLL-LATHE.

STEEL MAKING AT ENSLEY, ALABAMA.

STEEL MAKING AT ENSLEY, ALABAMA.*

By DAY ALLEN WILLEY.

THE city of Ensley, Alabama, will always be notable in the development of steel making in the United States, since here was really inaugurated the era of steel production in the South in November, 1899. True, open-hearth steel had been made in this section of the country prior to the construction of the Ensley plant, but in such small quantities that the attempts could only be considered experimental. The test furnaces at Birmingham and Fort Payne are familiar to metal manufacturers, for the reason that they proved basic steel of good quality could be turned out from the material available in the Birmingham district, and while both operations were but temporary, they were factors in arousing an interest in the subject that led to the building of the Ensley plant. However, it was not until the Tennessee Coal, Iron and Railroad Company had sold over 200,000 tons of basic pig iron for use in Northern furnaces that it decided to have its own works. These were built by the Alabama Steel and Shipbuilding Company, which is practically a division of the Tennessee corporation.

The steel plant site was well selected, being about midway between a group of the Pratt coal mines of the Tennessee Company and its Ensley iron furnaces, the fuel thus coming in at one end of the plant and the metal at the other. The Ensley group of the Tennessee Company's furnace and coking plants is especially favored in accessibility of material, as the Red Mountain ore mines are ten miles distant, and limestone and dolomite quarries are half that distance. The tipples of slopes 3, 4 and 5 of the Pratt mines, with coke ovens, but a few hundred feet off, are only a fraction of a mile distant from steel plant or furnaces. For the assembling of all materials for steel making, the location is unequaled in the district, and probably in the country.

The gas-producer plant, which is ranged parallel with the furnaces, consists of thirty-two producers, over which two tracks are carried on a trestle, loaded cars being brought in on one track and empties taken out over the other. The coal is dropped into steel bins, from which it is fed by gravity into the steel hoppers of the producers. The ashes drop into cars carried on a track under the producers. On a continuation of the trestle leading to the producers are the ore and limestone bins, which are also of steel, provided with chutes and spouts. From these the materials are dropped into charging boxes on cars, which are run into the open-hearth building from the side, on tracks connected with the main charging track. While on the stock end of the plant, mention should be made of the skull-cracker, located in the yard to the west of the furnace building, that being the direction from which come ore, coal, and limestone. The track leading to the drop from the casting level of the open-hearth building rises six feet to the drop, and the track from the charging level descends six feet, tracks on the two levels, which are twelve feet apart, thus having a loop connection in the rear of the skull-cracker. The latter consists of a tripod, and the drop is operated by a winding drum driven by a 25-horse-power motor.

The steel building in which are the open-hearth furnaces is 737 x 80 feet. There are ten Wellman tilting furnaces, of 50 tons capacity each. On the charging side of the furnace building, which is on the general yard level, are two Wellman high-type charging machines, which make it possible for two men to charge the ten furnaces and handle nearly 1,000 tons of material in twenty-four hours. Eight-foot charging boxes are used. The ports of the furnaces are fitted for quick changes, without interruption of the operation of the furnace. They are commanded by two cranes on the casting side, each of 40 tons capacity. These cranes also handle the fore-hearths, by which the use of ladles in casting is dispensed with. Two ingots are poured at once through the fore-hearth. The tilting of the furnaces at casting is accomplished by means of a 20-inch hydraulic cylinder. The ingot cars, each of which carries two ingots, are moved during casting by an electric car pusher, instead of the hydraulic pusher often employed. While in front of the furnaces, the car pusher is supplied directly with the electrical current, and is operated from a platform on the side of the building on which the controller stands. Provision is made also for the use of storage electricity by the pusher. Cinder from the furnaces is drawn out into Weimer cinder cars, and taken away hot. The train of ingots is drawn by locomotive to the stripping house, located just outside the open-hearth building, where the molds are removed by a vertical hydraulic stripper, and placed on cars on a parallel track. From the stripper the original practice was to take the ingots through a long heating furnace flue, coal-fired. Through this flue the ingots passed while still on the cars, the latter being protected from the heat by being submerged in water carried in a trough at the bottom of the flue. The flue served as a preheating furnace, after passing through which the ingots were taken to the heating furnace at the end of the blooming-mill building, charging being accomplished by a powerful electric charging machine. The preheating flue has since been dispensed with, however, and soaking-pit furnaces built. There are four four-hole pit furnaces, each furnace thus accommodating the sixteen ingots made in a single cast.

The blooming mill, of the Frank Kneeland type, is a 44-inch, two-high reversing mill, driven by a pair of 36 x 48-inch Allis engines, geared 2 to 1. It is capable of a wide range of service, housings being high and the spindle of unusual length. It will roll material from 4 x 4-inch billets up to slabs 36 inches in width. A feature of the blooming mill is the electrical screw-down, which is driven by a 100-horse-power motor. The engine which drives the blooming mill has steel gears cut without clearance, doing away with all backlash. From seventeen to nineteen passes are required to bloom down from an 18 x 20 ingot to a 4 x 4-inch section. The manipulator of the blooming mill is supplemented by a flexible arrangement of side-guards. The latter, which are provided both in front of the mill and on the back table, are 24 inches high and movable, being operated from the pulpit by hydraulic cylinders. They thus command any pass, and make it possible to hold the widest slab immediately in front of the pass. The blooming mill tables are operated by Crane reversing engines. The ingot manipulator and the shear tables are operated by 25-horse-power Westinghouse motors. The blooming mill is served by a 30-ton electric crane.

GENERAL VIEW OF THE BLOOMING MILL.

STEEL MAKING AT ENSLEY.

From the blooming mill the piece is conveyed by electrically-driven tables to a 26-inch three-cylinder Kneeland shear. Any one of the cylinders can be used alone, and the shear will cut blooms and slabs up to 10 x 36 inches. The large shear cuts a 4 x 4 piece into two, and each half passes on to a 12-inch duplex hydraulic shear, from which the billets drop down an incline into a chute, and thence upon a billet conveyor. On the latter they are carried to the adjoining rod mill of the Alabama Steel and Wire mill, being delivered automatically into the rod-heating furnace, each billet as it enters the furnace pushing another out at the opposite end.

Provision is made so that the blooming mill may work alternately soft steel for the rod mill and higher carbon steel for the rail mill. For example, a low-carbon ingot can be bloomed down to a 5 x 7 section, and pass directly to the first roughing stand of the rail mill, where it will be rolled down to 4 x 4, and thence returned to the duplex shear, cut into billets, and dropped upon the conveyor leading to the rod mill. Meantime a rail ingot may be brought down to an 8 x 8 section on the blooming mill, sheared by the three-cylinder shear, and the pieces finished in the rail mill. There is thus provision for great flexibility in operation and the attainment of large outputs, with the attendant economies.

The rod mill, which has been erected on a site adjoining the steel-making plant, is equipped with machinery for the rolling of rods and drawing of wire, as well as the manufacture of barbed and plain wire fencing, nails, and other staples. The two plants are so near together that billets are taken from the cutting-up shears in the blooming mill, and carried as described by a conveyor direct to the heating furnaces of the roughing train in the rod mill, thus avoiding all expense for handling or freight. The rod mill contains a Garrett mill, designed with a view to output and economy. The nail machines were built from original designs by the engineers of the mill, and, in fact, nearly everything about the plant has been designed to meet the requirements of this particular case. The wire-drawing benches and most of the rough machinery and castings were made on the spot, a foundry and machine shop having been installed for this and subsequent work. The plant is a large one, covering a large part of the 20-acre tract, and produces everything from the billets to the nail kegs. The mill is large enough to take 300 tons of billets daily. The rail mill may also be called a finishing plant, since it turns out not only rails of the standard sizes, but beams, channels, and angle steel. Railroad engineers have been specially interested in this plant, as it is claimed that the basic rails are of such a superior quality that they have 25 per cent more durability than the ordinary Bessemer rail. Quantities have been sold to a number of the larger transportation companies to test their wearing qualities. This mill when running to its full capacity is large enough to take all the steel from the furnaces, excluding that consumed in the wire plant.

The rail mill is driven by a 52 x 72-inch engine. The boiler equipment of the steel works proper, however, represents 4,500 horse-power, arranged in fifteen units of 300 horse-power each, with provision made for five additional units when desired. Other equipment in the main power house are two 225-kilowatt Westinghouse generators, each driven by a direct-connected 20 x 30 Buckeye engine. These supply electricity for power and lighting. There are two Ingersoll-Sergeant air compressors, which furnish air at 80 pounds pressure for operating the open-hearth furnace doors and reversing the gas and air valves. An ingenious provision on these compressors secures automatic regulation of the pressure, dropping it back to 80 pounds when the 100-pound point is reached, and bringing it up to 80 when it falls below.

Hydraulic power is used in tilting the furnaces, for operating the ingot stripper and the slab and billet shears. It is supplied by two pumps, 25 x 42 and 10 x 36 respectively.

A brief reference may be made to the auxiliary plants at the Ensley works. From the beehive coke ovens to the furnaces the distance is about 2,500 feet. Immediately beside the furnaces is a Semet-Solvay plant of retort ovens. The coke from each oven is pushed directly into an iron car, quenched, and hauled up an incline by cable into the stockhouse of the furnace, with neither handling nor freight. The ovens are heated by gas generated from the coal, and as there is more gas than is required for this, it is piped to the boiler plant of the furnaces, and used there whenever needed to supplement the gas taken from the furnace tops. The tar and ammoniacal liquor distilled from the coal are recovered, the tar being subjected to several subsequent distillations, while the liquor is shipped for further treatment elsewhere.

The saving of by-products in coking on one side of the Ensley furnaces has its interesting counterpart on the other side in the plant of the Birmingham Cement Company, where slag taken hot from the furnaces is granulated, dried, finely ground, and mixed with lime and other ingredients to make hydraulic cement, upon practically the same principle that the manufacture of cement from blast-furnace slag is carried on at the works of the Illinois Steel Company in Chicago and the Maryland Steel Company at Sparrow's Point, Maryland.

The furnace plant, which began operations on November 30, 1899, was built under the supervision of the Wellman-Seaver Engineering Company, acting as consulting and contracting engineers.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

Correspondence.

RADIUM A TRANSFORMER.

To the Editor of the SCIENTIFIC AMERICAN:

The compounds of radium and uranium exhibited in St. Louis and in other places are nothing more than substances changing the frequencies or rate per second of the invisible waves they receive, and then giving off these waves in the more easily perceived forms of waves.

That it is not the metals themselves or compounds of them that give off the waves causing skeleton pictures, phosphorescing diamonds, heat, etc., but that these compounds act only as transformers, having no energy of their own whatsoever; that they could not be used independently, but are entirely dependent on the invisible waves coming from the interior of the earth and striking such compounds and being transformed to lower frequencies, may be understood by the following similes: First in the list which I have prepared, are the sound waves (from 16 to 60,000 waves per second, that is, from the lowest to the highest note on the musical instruments, any one of which may be struck in such a manner as to cause a tone of a higher frequency than the note itself. These are called overtones and are most easily produced on the lower keys of the piano. If a stretched wire is struck in the middle, a note will be given off one octave higher than would be given off if struck as they are in the pianos, that is, twice as many vibrations per second will be given off. This, then, is the first frequency transformer of the invisible waves.

Another simile is that of the visible waves (from 350 trillion to 700 trillion per second)—the waves of light. These waves when driven through a prism of glass (wedge-shaped crystal) are transformed into all colors and many invisible waves above and below the colors, some of which are penetrative to the same materials as are the waves from the so-called "radio-active" compounds.

From these it seems that uranium and radium might well send off waves for an indefinite number of years, "producing" even heat and light in proportion to the amount of invisible waves of gravitation they receive from the earth. J. C. FEATHERSTONE.

ORIGIN OF RADIUM.

No well authenticated discovery made in the last half century—not even that of the distance to which Hertz waves can be transmitted—has stimulated bolder conjectures than have the announcements of M. and Mme. Curie. What will be the outcome of this speculation cannot now be foretold, but already a number of amazing guesses and theories have been inspired by the properties of radium, considered apart from the other phenomena of nature.

Only a few weeks ago Prof. Rutherford, of Montreal, created a sensation while lecturing before a scientific audience in London by suggesting that the earth is much younger than astronomers and physicists have believed. That possibility had occurred to him in consequence of observing the rapid rate at which radium decays. Supposing this to be uniform, he estimates that all which is at present in existence will have disintegrated in a thousand years, and that all which existed a thousand years ago must now have become transformed into something else—helium, perhaps. Prof. Joly, of Dublin, reaches an astonishingly different conclusion concerning the earth's age, by confining his attention to the behavior of another metal, uranium. It has been observed in a laboratory that this metal apparently breaks down, but much more slowly than radium. Of a given amount of uranium only a ten-thousand-millionth part decays in a year. Adopting that element as a standard, then, the Irish physicist says that 10,000,000,000 years may be regarded "a minor limit to the antiquity of matter in our part of the universe." Rutherford and Joly cannot both be right, apparently, and perhaps neither of them is. Lord Kelvin's estimate of the time which has elapsed since the globe cooled sufficiently to sustain animal and vegetable life was between 10,000,000 and 20,000,000. Even the most exacting biologists and geologists demand more than 100,000,000. Prof. Joly's guess exceeds these others a hundred or a thousand fold!

A good deal of attention is now being given to the probable origin of radium. Whether the element, while still intermingled with other substances in the ores in which it is found, undergoes change as rapidly as it does after separation, is a question not yet answered. However, whether its fixity is greater in the one case than in the other, grave doubts of its permanence are entertained by most of the men who are now studying the element. A possibility which has occurred to several minds almost simultaneously is that radium is a product of uranium. The two were invariably associated in the pitchblende from which the Curies extracted radium. Dr. Bertram B. Boltwood, of Yale University, has made tests with various ores that lead him to think that the quantities present always bear the same relation to each other. W. C. D. Whetham, of Cambridge, England, says that every time he has obtained what was sold to him as a pure salt of uranium he would find traces of radium in it. He has also examined specimens of uranium compounds that have been preserved in the Cambridge laboratory for periods ranging from seventeen to twenty-five years, and in every instance they contained radium.

Finally, Frederick Soddy, who co-operated with Rutherford in some of the latter's earlier work, but is now identified with University College in London, reports in Nature a set of experiments which he is now conducting. He obtained a thousand grammes of uranium nitrate twelve months ago. He purified it so that he could detect the presence of only a microscopic trace of radium. The proportion which the amount of the latter bore to the mass of the former would be represented with a "1" preceded by a decimal point and sixteen ciphers. At the end of a year, Mr. Soddy tested again, and found a little more, but not as much as he thought he should have obtained if the added quantity came from uranium. There may have been something wrong with his test, or else with his computations, and Mr. Soddy will continue the observations from time to time. Inasmuch as the amount of radium discovered at the end of the year was only a ten-thousandth part of that which his and Sir William Ramsay's theories promised, he says: "This practically settles the question so far as the production of radium is concerned. . . . The result, of course, may be explained by assuming the existence of intermediate forms between uranium and radium. But . . . several such hypothetical forms, each with an extended life, must be assumed. So that, unless modifications are made in the theory which at present are not justifiable, the evidence may be taken as indicating that uranium is not the parent element of radium."

Rutherford, in a recent book, published before Mr. Soddy's letter appeared in Nature, said: "Since radium has a short life, compared with that of uranium, the amount of radium produced should reach a maximum after a few thousand years, when the rate of production of fresh radium—which is also a measure of the rate of change of uranium—balances the rate of change of that product" (into helium).

Prof. Joly, after briefly indicating the improbability that radium may be the offspring of thorium, suggests that it may not result directly and solely from decay. Perhaps it may be a combination of the radio-active products of some disintegrating element with one of the many substances found in pitchblende. Particles and properties derived from either uranium or thorium might have united with bismuth or barium, for instance. "Thus radium would represent the synthesis, not the decomposition, of an element." Prof. Joly adds. He therefore advises that a watch for the genesis of the new element in pitchblende and allied minerals be undertaken.

How extensively radium now exists, or has existed, in other celestial bodies than the earth is a question of profound interest both to astronomers and chemists. If positive information on this point could be obtained, it might aid the experts in determining its origin and history in the globe. There has been a disposition to take it for granted that the stars are all composed of substantially the same materials. By the spectroscope it has been possible to identify with certainty nearly forty terrestrial elements in the sun. Lockyer thought that he saw evidence of several others—uranium among them—in the same luminous envelope of vapor. What is contained at greater depths can only be conjectured, but positive recognition of more than half of the elements found on the earth is certainly suggestive. A still more impressive fact is that a large number of stars—which astronomers say are also suns—give a spectrum like the great body on which the earth is dependent for light and heat. Arcturus and Capella are notable representatives of this "solar" type of stars.

Other types are characterized by different spectra from this one. Instead of showing the lines of calcium, iron, sodium and nearly twoscore other metals, they betray the presence of little except helium and hydrogen gases. The suspicion is entertained, however, that the dissimilarity indicates differences in temperature only, and not of composition. Although the astronomers are not in perfect harmony concerning the meaning of the lack of agreement in stellar spectra, many of them look at the intensely white stars, which give a helium or hydrogen spectrum, as younger and hotter than the yellow, or "solar," stars; whereas the red, or "carbon," stars are considered cooler and perhaps older than any of the others. The practical unity of the material of which the whole visible universe is constructed is held to be possible, if not probable; and hence the particular elements which are the most conspicuous in any one group are accepted as indications of the stage of development attained by the members of that family.

No one has yet found evidence of the presence of radium in the sun. That fact proves little, though. Radium is one of the heaviest elements known. Astronomical spectroscopists have suggested that the failure to detect platinum, thorium and iridium in the sun and the dubious indications given concerning uranium may be due to their great weight. The same explanation would apply to radium. There is almost as much reason for thinking that the latter exists in the sun and the other stars as there is to imagine that they contain platinum and uranium. The chief doubt is suggested by the belief of Sir William Ramsay that radium is an exceedingly "unstable" element, that the helium which has been obtained from it in a few instances was really a product of transformation, and that the gas was not simply liberated from a previous association with the metal. Of course, if all the radium which ever existed in the universe has now been converted into helium, and if a new stock of radium is not being manufactured out of other materials, then the supply has given out entirely. However, neither of these suppositions is yet warrantable. So long as one must rely on guesses alone, he is excusable for thinking that many other bodies besides the earth contain radium, though they do not show it. The case for transmutation has not been established, but even if it had been the theory would be applicable to the fresh manufacture as well as the disappearance of this strange element.

Whether or not the helium now observed in many of the stars has resulted from the decay of another element or has maintained its individuality as long as its associates, it is found in many of the nebulæ and in certain bodies which are involved in "cosmic fog." In these facts some astronomers find a hint that the Pleiades, the brighter orbs in Orion and certain other conspicuous helium stars are of comparatively recent birth, and that younger sisters are even now being developed out of the same chaotic and tenuous mist. —N. Y. Tribune.

PRACTICAL METHOD FOR PRODUCING COMPRESSED TABLETS.

ACCORDING to Wiedeman in the Pharmazeutische Praxis, the production of the material to be compressed is the most difficult part of tablet making. Since every substance has its peculiarities, and for that reason must be handled differently, still the main features of the process remain the same. First of all the ingredients must be reduced to powder, then granulated, dried and finally slightly moistened, made slippery, to be in a condition suitable for compression. For granulating, the carefully mixed powder is in most cases moistened with water, diluted alcohol, or a watery syrup solution. Water alone gives the hardest grains, which do not crumble in handling. The powder is wetted to the consistency of bread dough and rubbed through a No. 16 or 20 sieve—having a mesh of 40 to 60 to the square centimeter—and dried. For small tablets a No. 16 sieve is better. The drying may be effected either in the open air or recourse may be had to the oven, though when spread out on paper in a dry place, and covered with a sheet of paper to keep off the dust, the grains dry very quickly.

When thoroughly dried they are rendered "slippery," for which purpose many different substances are used. The manufacturers sprinkle the grains with liquid vaseline, 10 to 12 drops to a pound; they add furthermore 2 per cent of talc to prevent the tablets from sticking to the press.

The author of this article does not consider this satisfactory, for if only a few drops too much of the vaseline be added, the mass cannot be compressed. To avoid such a contingency French chalk should rather be used and the process may then be carried forward with the best results. The material is now ready for compression. The tablets should not be too hard to dissolve easily when they reach the stomach, nor so soft that they crumble when handled.

To make them easily soluble, a neutral powder consisting of five parts of sugar of milk and one part of cane sugar should first be mixed with the ingredients. With a stock compressor one hundred tablets may be turned out every minute with one turn of the crank.

Not a few substances may be compressed without any previous preparation, since the manufacturers furnish them in granulated form. To this class belong, for example, salol, ammonium chloride, the bromides and iodides, and potassium chlorate.

Most tablets are prepared in this way, but a few require special manipulation. Sodium salicylate, for instance, must be granulated with a gum, syrup of acacia; quinine sulphate demands the addition of 5 per cent of pulverized gum arabic and 10 per cent of pulverized cane sugar. Several other sort of tablets require peculiar treatment, and the correct method can only be learned by practical experiment.

An apothecary, however, who prepares his own tablets can always do so from 10 to 15 per cent cheaper than he can procure them from the wholesale houses or manufacturers, except such as potassium chlorate and ammonium chloride tablets. With proper use the outlay for a compressor is soon recovered.

EXPERIMENTS IN FORCING PLANTS BY ETHER.*

By EMILE GUARINI.

SOME curious experiments on the forcing of plants that have recently been made at the State Botanical Garden of Brussels will certainly prove of interest to horticulturists, who will doubtless profit by them. These were performed with ether, according to a lately invented process. One of them was tried upon the *Azalea mollis*, a bushy, spring-blooming plant that puts forth handsome flowers in March or April at the ordinary temperature of a cold green-house and earlier still when it is submitted to a temperature of 15 deg. to 20 deg. C. (59 deg. to 68 deg. F.).

Toward the middle of December, pots of this plant were placed in a box and submitted for forty-eight hours to the vapor of ether, in the proportion of 450 grammes of the latter to one cubic meter of air (44 ounces avoirdupois to one cubic foot) at a temperature of 18 or 20 deg. C. (64.4 deg. or 68 deg. F.). They were left at this temperature at the same time as were some non-etherized plants. At the end of four weeks, the flowers of the plants submitted to the vapors of ether were completely expanded, while the others had undergone scarcely any development. The 65 centimes (13 cents) worth of ether (per cubic meter of air) had therefore caused a gain of six weeks in the forcing with a great saving in fuel.

The other experiment was made upon the *Mimosa*, a charming flower that reaches Belgium in full blossom from Nice. Unfortunately, the packing and journey affect the freshness and preservation of the mimosa, and it would prove advantageous to cause the

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

plant to flower in Belgium. For this purpose, it will suffice to submit some branches immersed in water at the base to the vapor of ether and a temperature of 25 deg. C. (77 deg. F.) in a perfectly tight box. After twenty-four hours the flowers will be found to be fully expanded, and may be easily preserved. Another advantage of the process that is not to be lost sight of is that the mimosa-flowers are not only of a finer quality, but are much cheaper, since an 11-pound basket of branches costs but five francs ($1.00), inclusive of freight.

ELECTRIC POCKET LAMPS.

THE incandescent electric lamp had scarcely entered the domain of practice, when the use of it soon became general under the most varied forms. Shortly after its advent, the idea occurred to employ it in exceedingly small sizes capable of being housed in surgical instruments, such as the laryngoscope, or in ornamental objects, such as scarf pins. M. Trouvé, who was one of the first to direct his attention to applications of this kind, employed as a source of electricity small reversible batteries consisting of a hard rubber jar containing a carbon cylinder, in the center of which was placed a zinc cylinder. The exciting liquid used was a solution of a salt of mercury. Later on, M. Aboilard employed for the same purpose small lead accumulators. In both cases the inconvenience of the oozing out of an acid liquid was encountered, as it was impossible for the closing of the battery or the accumulator to be hermetical on account of the disengagement of the gases. On the other hand, the manufacture of minute lamps was far from being perfect, and although they were very expensive, they lasted but a very short time. These various reasons explain the want of success of the application of minute and portable sources of light.

At present, the incandescent lamp is manufactured at a lower figure and of a good quality. The battery is nearly dry, without acid, and without any oozing, and so, on all sides, we see the most varied and often unexpected applications under all sorts of forms. Among the prominent houses engaged in this branch of industry in Paris, may be mentioned that of MM. Henry and Lenud, the most important part of whose business is the manufacture of very small batteries of the Leclanché type, some of which are scarcely .78 of an inch in diameter by 2.36 inches in height. By means of a press, there is agglomerated around a stick of carbon *C* (Fig. 2), a finely pulverized mixture, *D*, of carbon and binoxide of manganese, and the cylinder thus formed is then covered with a coarse fabric and slid into a zinc cylinder *F*, containing a thick paste *E*, of a hydrochlorate of ammonia basis. The tube is closed by means of a layer of tar, care being taken to leave an exit for the gas through a capillary tube inserted in the mass. The top of the stick of carbon, which alone projects, is provided with a copper cap *A*, which forms the positive pole, the zinc jacket forming the negative.

On account of the low figure at which these elements must be sold at wholesale, the cost of manufacture must be very low, and this is made possible by a well regulated division of labor. As each workman always manufactures the same part, he succeeds in doing his work quickly and well. This little battery, upon the whole, is the important part of the new industry, for, whatever be the ingenuity, utility, or elegance of the various apparatus that it supplies, the latter would soon be discredited if, the battery being once exhausted, they were put out of service. It is necessary, then (and this result is now attained), that it shall be possible to easily procure, at a low price, interchangeable elements adaptable to all the apparatus found in the market. The electric capacity naturally varies with the size of the elements; but even in the smallest, it is possible to depend upon a duration of one hour's lighting. It must not be forgotten that the object of the battery is not to furnish a continuous light, and in giving it the name of "ten thousand flashes," the manufacturers have well characterized the use for which they design it—that of lighting intermittently.

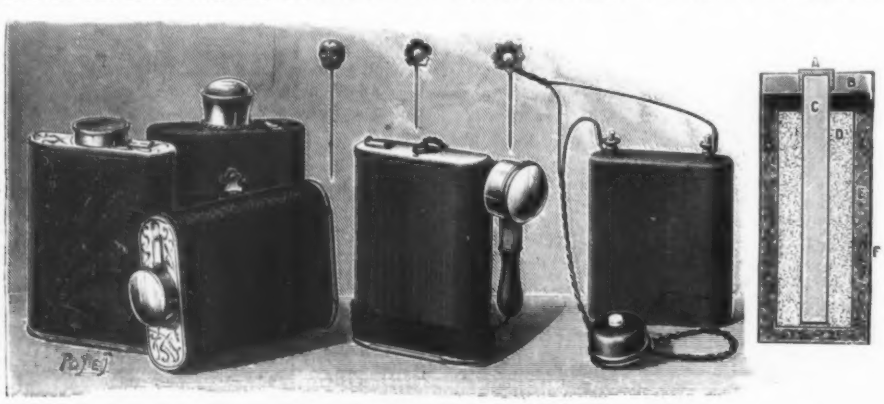


FIG. 2.—SECTION OF THE HENRY & LENUD DRY BATTERY. ELECTRIC POCKET LAMPS AND LUMINOUS SCARF PINS.

The objects to which they apply the instantaneous light are exceedingly numerous, and all of them, as well as the lamps, are of their own manufacture.

In canes (Fig. 1), the battery, composed of two or three elements placed end to end, can be introduced either into the stock or the head, according to the form of the latter. The candlestick comprises the same arrangement of the batteries. In the pocket lamps (Fig. 2), the batteries are placed alongside of each other, and are delivered to the trade coupled in series, so that there shall be no necessity of making connections. The same is the case with the battery for supplying scarf-pins. We must particularly mention one type of battery, with an incandescent lamp, that permits bicyclists easily to read an indication upon a card, despite wind and rain, aeronauts to provide themselves with a light notwithstanding the proximity of the gas of the balloon, and photographers, by providing it with a red glass, to have a light for use in their dark room lamp. It is the same system, moreover, that is designed for the use of physicians in the examination of a throat at the bedside of the patient. We shall not dwell upon a description of the varied objects that are capable of receiving this ever-ready and convenient source of light, such as lamps for entering a house with when the gas is extinguished; for looking for something in a dark closet; for seeing the time of night, etc. These are all in constant use in everyday life, and the cordial reception that they have received from the public is a proof that they fill a long-felt want.—Translated from La Nature for the SCIENTIFIC AMERICAN SUPPLEMENT.

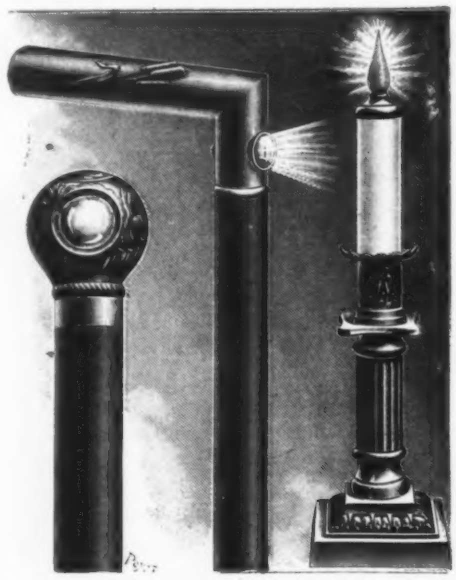


FIG. 1.—CANES AND CANDLESTICK WITH INCANDESCENT ELECTRIC LIGHT.

CONTEMPORARY ELECTRICAL SCIENCE.*

RE-COMBINATION OF IONS.—R. K. MacClung showed on a previous occasion, that over a considerable range of pressures, both above and below atmospheric pressure, the rate of re-combination of ions is governed by Rutherford's law, according to which the rate varies as the square of the density of the ions. He has now completed a series of experiments undertaken with the object of ascertaining, in the first place, whether this same law of re-combination holds at various temperatures of the air, and, secondly, what effect a change of temperature of the gas has upon the value of the coefficient of re-combination. The Röntgen ray bulb and the induction coil which runs it were, as usual, inclosed in a lead-covered box as a shield, and the rays were allowed to emerge through a circular opening in the lead. The apparatus was inclosed in an iron cylinder heated by a long Bunsen burner. The results show that Rutherford's law applies to all temperatures covered by the experiments, which ranged from 15 to 300 deg. C. The coefficient of re-combination, however, increases rapidly at the higher temperatures, being 35 at 15 deg., 65 at 135 deg., and 270 at 270 deg. The relation between the coefficient of re-combination and the temperature does not seem a very simple one, for the curve showing the connection between them does not seem capable of being represented by any simple mathematical formula. Whatever the changes are which take place among the ions, either in the individual ions or in their relations to one another when the gas is heated, they would appear from this to be somewhat complicated.—R. K. MacClung, Phil. Mag., December, 1903.

MAGNETIZATION IN VOLCANIC ROCKS.—B. Brunhes and P. David have made some interesting magnetic observations in connection with the magnetism of volcanic rocks which recall the work of Folgheraiter on the magnetism of the Tuscan vases and his conclusions as to the dip in Italy about 1,000 years before the Christian era. The authors go back much further than this by means of measurements carried out on the burnt clays and lavas of the Puy de Dome. In several places, flows of lava have covered beds of pliocene or quaternary clay, baking them to a depth of several meters, and producing what is known as "natural brick." This natural brick has a magnetization different from that which would be produced by the earth's field as it exists at present, and may, as has already been shown, be considered to have retained the magnetization imparted to it at the time it was baked. The magnetic dip indicated by the brick ranges from 70 deg. to 72 deg. The covering lava shows a dip which is a few degrees less than that, but its composition is less uniform, and it may be supposed that it preserved the original dip less perfectly. The declination can also be determined in this case, whereas it could not be fixed in the case of the vases. It is some 50 deg. or 60 deg. in excess of the present declination. A convincing counter-proof is brought by the fact that a basalt found underneath the clay, and evidently due to a previous flow, shows a dip of only 59 deg. 40 min., and a declination only 1 deg. west of its present value.—Brunhes and David, Comptes Rendus, December 7, 1903.

SPECTRA AND ATOMIC WEIGHTS.—C. Runge calls attention to the importance of taking "homologous" lines in calculating the atomic weights of new elements from those of known elements, by means of their spectra. According to Ramage, a diagram may be drawn with oscillation frequencies as abscissæ and the squares of the atomic weights as ordinates. In this way each spectrum is represented by certain points on a parallel to the axis of abscissæ, the distance from its axis being proportional to the square of the atomic weight. In many cases the points representing homologous spectrum lines lie approximately in a straight line. The atomic weight of an element may thus be determined from the atomic weights of two other elements as soon as three homologous lines are known in their spectra. Homologous lines are marked by similar behavior in the Bunsen flame, in the arc and in the magnetic field. But if care is not taken to insure that the lines chosen for calculation are really homologous, the atomic weight of a substance may be made almost anything we please. This fault the author attributes to Watts in his calculation of the atomic weight of radium, which, according to him, may be anything from 177 to 233. The law found by Precht and Runge, that the differences of the oscillation frequencies of homologous doublets are proportional to some power of the atomic weight—in other words, that the logarithm of the difference is a linear function of the logarithm of the atomic weight—seems to furnish a better means to calculate the atomic weight from its spectrum. It makes the atomic weight of radium 258. Whether this value or the value found by Mme. Curie, 225, be the right one is as yet open to discussion.—C. Runge, Phil. Mag., December, 1903.

COMPARISON OF COLORED LIGHTS.—We know already that the curves connecting the brightness of light with its objective intensity differ for different colors. According to Purkinje, if a red patch and a blue patch have apparently the same intensity, and the intensity of both is diminished in the same ratio, the blue patch appears much brighter than the red patch. A. Broca and D. Sulzer have found that there is another element which also complicates the work of color photometry. It is the element of time. It is very much more pronounced in its action than the effect observed by Purkinje, and increases markedly with the brightness. If a blue light and a light of another color have the same brightness while steady, they have a very different brightness when they act upon the retina during a fraction of a thousandth of a second. Since the blue impresses itself much more quickly upon the eye than any other light, it appears much brighter in comparison. There must, of course, be a maximum of divergence, and this maximum occurs at a time interval of about 0.00007 second. Red appears brighter than green, but the difference is very much less marked. The comparative brightness of the blue may be four or five times its normal brightness. But this large preponderance rapidly dies away, owing to the fatigue of the eye. This can only be avoided by allowing the flashes to occur at intervals of more than two seconds, which allows the products of retinal fatigue time to get absorbed.—Broca and Sulzer, Comptes Rendus.

* Compiled by E. E. Fournier d'Albe in the Electrician.

Ice Crusher Wanted in Canada.—The Dominion government has announced that it is in the market for an ice crusher for use in the St. Lawrence River. Previously, the sum of $300,000 had been placed in the estimates for building an ice crusher. The general plan is for a steamer 200 feet long, 43-foot beam, and 18 feet deep, having specially constructed machinery for working during the winter and engaging in the

lighthouse and buoy work in the summer. The department of public works invites bids for the construction of a wharf at Chambord, Ontario, as well as a breakwater at Medford, Ontario.—W. R. Holloway, Consul General, Halifax, Nova Scotia.

[Concluded from SUPPLEMENT No. 1489, page 23866.]

WATER-SOFTENING.*

AN INQUIRY INTO THE WORKING OF VARIOUS WATER-SOFTENERS.

By C. E. STROMEYER and W. B. BARON, of Manchester.

The Reisert Water-Softener. Type E.

THE apparatus, Fig. 13, consists of a large settling tank and filter combined, over which is placed a distributor. In addition there is a conical lime tank and a cylindrical soda tank. Pipes with carefully gaged apertures lead the water from the distributor to the top of the soda tank and to the bottom of the lime tank and to the bottom of the settling tank. A siphon from the soda tank and an overflow from the lime tank are also led into the bottom of the reaction tank. A pipe passes from the supply under the filter for automatically washing away the precipitate on the filter when the resistance is increased so much as to raise the water level. The mud in the settling tank is drawn off through a sludge cock.

Capacity.—1,300 gallons per hour.

Dimensions.—Settling tank, 5 feet 3 inches diameter. Lime tank, 3 feet 9 inches diameter at top to 6 inches at bottom. Total height, 22 feet 6 inches. Floor space, 41 square feet.

About 2,000 of these softeners, of various sizes, are said to be in use on the Continent.

Working.—The correct quantity of lime is placed in a small tank, slaked, and converted into milk of lime, which is then run into the bottom of the conical lime tank. The right quantity of soda and water is placed in the cylindrical soda tank, and steam is turned on until the soda is dissolved and the contents of the tank well mixed and of uniform density. The water supply, which has been temporarily stopped, is now restarted, and passes from the distributor through three carefully gaged holes. One portion goes direct to the bottom of the settling tank into a little mixing chamber. Another portion flows to the bottom of the lime tank, the same quantity of concentrated lime water flowing off the top of this tank into the mixing chamber. The third portion of water is led to the top of the soda tank, and, being lighter than the soda solution, it floats on its surface, and, by depressing it, causes it to rise up the siphon pipe to the mixing chamber. The three fluids being well mixed, precipitation takes place, the sludge settling in the bottom of the settling tank and being drawn off occasionally. The partly clarified water passes through a pipe to the bottom of the gravel filter, where the remaining precipitate is removed, and the purified water then passes to the feed pump. The filter is occasionally cleaned by an automatic reversal of the flow, whenever the filter is fouled. The mud passes down the waste pipe.

Supply.—Well water.

Chemicals used per 1,000 gallons.—2.7 pounds lime and 1.4 pounds soda.

The users report that the apparatus has worked satisfactorily for 2½ years, and that the boilers have given no trouble. It takes one man half an hour every 12 hours to charge the chemicals.

Result of Chemical Analysis.—This is one of the few softeners in which an excess of lime was added, with the result that nearly all the magnesia has been removed, but the excess of lime has also caused the temporary hardness to be fairly high—namely, 4.4 deg. The treated water also shows 3.5 deg. of permanent hardness, which could have been entirely removed if enough soda had been added. This insufficiency of soda is probably partly due to the presence of sulphate of lime as an impurity in the burnt lime.

The Stanhope Continuous Water Softener.

The apparatus, Fig. 14, consists of a lime mixing tank, with a small compartment for the mixing chain, a reaction tank and a settling tank with inverted perforated funnels and a filter. Above these cylindrical tanks is a distributor, a soda tank and a lime slaking tank. The distributor has three carefully adjusted outlets, one discharging into the reaction tank, and one into the lime tank, and another into the soda tank. The chain in the lime mixing tank is driven by a water wheel.

Capacity.—2,500 gallons per hour, but worked at 1,000 gallons per hour.

Dimensions.—Settling tank, 7 feet 6 inches diameter over angles; reaction and settling tower, 5 feet 6 inches by 2 feet 6 inches over angles; height, 26 feet; floor space, 70 square feet.

About 90 of these softeners, of various sizes, are in use.

Working.—The water enters the distributor, the supply being regulated by a ball tap at the discharge. Three carefully gaged outlets lead this water respectively into the mixing tank, into the lime mixing tank, and into the soda tank. The slaking of the lime is done in a separate tank. The reaction between the lime, soda, and untreated water takes place at the same time. The treated water passes upward through perforations in the cones, and then through the filter. The sludge falls down through the openings in the

Fig. 13. REISERT

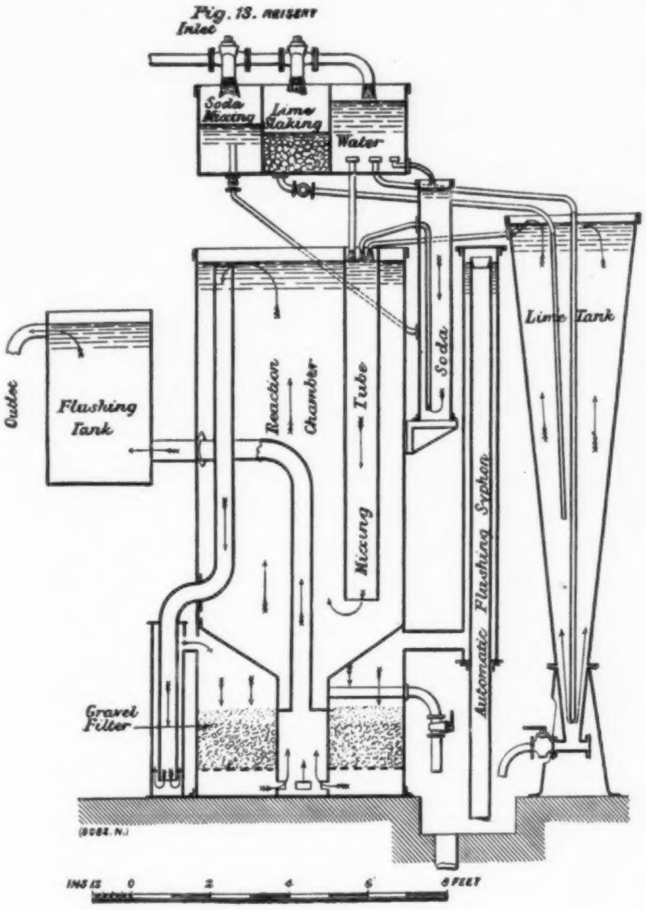


Fig. 16. WOLLASTON Sectional Elevat[n]

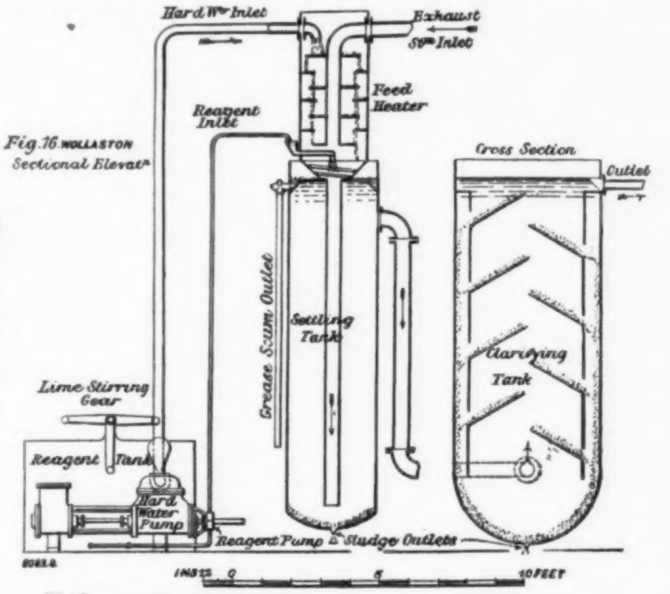


Fig. 17. WRIGHT

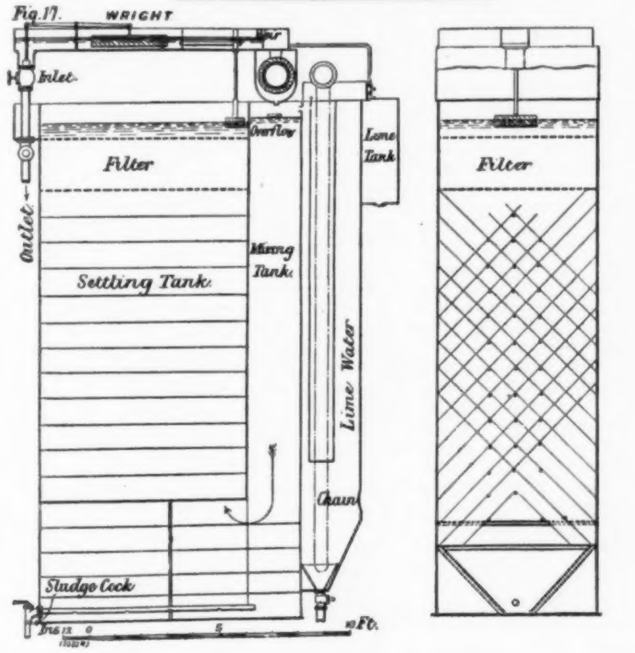


Fig. 14. STANHOPE CONTINUOUS

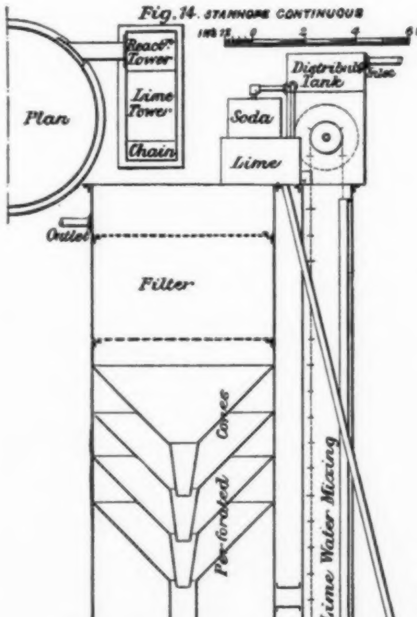
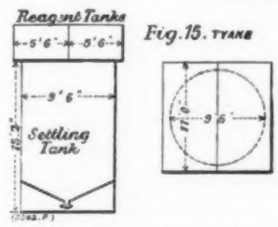


Fig. 15. TYAKE



WATER-SOFTENING APPARATUS.

* Paper read before the Institution of Mechanical Engineers.

center of the cones, and is run out of the sludge cock.

Supply.—Town water.

Chemicals used per 1,000 gallons.—0.5 pound lime, 0.5 pound soda crystals.

The users report that the sediment in the softener is easily removed. The filters are cleared twice a year, which takes about two days. Hardness of treated water varies from 2 deg. to 4.5 deg.

Result of Chemical Analysis.—Insufficient lime and soda were added, but as the water contained little magnesia salts, the result was a good one, the combined hardness being reduced to 2.6 deg.

APPENDIX III.

CHEMICAL ANALYSIS.

Chemicals, &c.	Chemical Symbols.	Archbutt-Deeley.		Atkins.		Babcock and Wilcox.			Bell.	
		Supply.	Delivery.	Supply.	Delivery.	Supply.	Delivery.	Delivery Less Steam.	Supply.*	Delivery.
Grains per Gallon.										
Carbonic-acid gas	CO_2	7.161	0.62	6.786	1.27	3.940	4.070	..	2.39	3.22
Scale forming constituents: Calcium Sulphate	$CaSO_4$	2.089	0.000	0.715	0.715	8.001	0.000	0.099	19.918	0.000
Calcium Carbonate	$CaCO_3$	6.859	1.704	13.909	1.709	2.549	6.319	9.972	0.090	1.708
Calcium Silicate	$CaSiO_3$	1.739	1.175	1.110	1.080	2.035	1.194	1.609	..	..
Magnesium Hydrate	$Mg(OH)_2$	..	..	..	..	..	..	..	..	..
Magnesium Carbonate	$MgCO_3$	5.418	0.073	..	..	3.339	1.306	2.154	3.619	3.596
Magnesium Silicate	$MgSiO_3$	..	..	..	..	..	..	..	0.913	0.800
Ferric oxide		0.399	0.148	0.034	0.017	0.611	0.006	0.013	0.006	0.005
Total		16.779	3.100	15.756	3.471	17.115	8.876	14.007	34.456	6.109
Non-scale forming constituents: Sodium Nitrate	$NaNO_3$	..	..	0.716	0.738	..	..	..	..	..
Sodium Chloride	$NaCl$	2.675	3.211	2.881	2.989	16.676	10.612	18.745	3.090	8.089
Sodium Sulphate	Na_2SO_4	0.000	5.402	..	..	32.730	28.045	41.100	12.491	38.700
Sodium Carbonate	Na_2CO_3	..	..	..	..	..	..	..	..	..
Sodium Bi-carbonate	$NaHCO_3$	0.000	1.401	..	..	0.000	11.923	18.815	0.000	9.844
Sodium Silicate	Na_2SiO_3									
Sodium Hydrate	$NaHO$									
Calcium Nitrate	$Ca(NO_3)_2$	..	..	2.983	2.982	..	..	..	..	..
Calcium Chloride	$CaCl_2$	..	..	..	..	..	..	..	..	..
Magnesium Nitrate	$Mg(NO_3)_2$	..	..	0.904	0.904	..	..	..	..	..
Magnesium Chloride	$MgCl_2$	0.251	0.000	..	..	..	..	..	..	..
Magnesium Sulphate	$MgSO_4$	..	..	..	..	..	..	..	10.662	0.600
Total		2.926	9.814	7.406	8.463	49.412	48.560	76.660	31.845	75.213
Total mineral matter		19.705	12.914	23.162	11.934	66.527	57.456	90.667	66.301	81.322
Alkalinity		14.582	3.002	14.080	2.330	8.757	10.060	28.960	5.199	12.629
Temporary hardness		14.587	2.799	14.080	2.320	8.757	8.954	14.131	5.199	6.770
Permanent hardness		2.203	0.000	3.165	3.165	5.883	0.000	0.000	30.888	0.000
Total hardness		16.785	2.799	17.845	5.485	14.640	8.954	14.131	36.057	0.770
Chemicals required in pounds per 1000 gallons.*										
Lime	CaO	1.80	-0.00	1.306	0.28	1.034	0.000	..	1.569	1.459
Soda	Na_2CO_3	0.35	-0.25	0.44	0.44	0.892	1.075	..	4.676	-0.898
Cost per 1000 gallons	Pence	0.41	..	0.380	..	0.635	..	..	2.922	..

Chemicals, &c.	Chemical Symbols.	Bort.			Carron.		Desrumaux.	
		Supply.	Delivery.	Delivery Less Steam.	Supply.	Delivery.	Supply.	Delivery.
Grains per Gallon.								
Carbonic-acid gas	CO_2	10.36	1.40	..	6.21	1.14	5.63	1.25
Calcium Sulphate	$CaSO_4$	17.136	4.582	5.734	33.105	3.420	2.983	0.635
Calcium Carbonate	$CaCO_3$	17.271	0.306	0.239	0.000	4.780	5.980	1.485
Calcium Silicate	$CaSiO_3$	2.176	1.560	1.874	2.693	3.902	1.909	0.163
Magnesium Hydrate	$Mg(OH)_2$	..	..	..	..	..	..	..
Magnesium Carbonate	$MgCO_3$	2.968	1.768	2.237	10.989	14.602	5.115	1.873
Magnesium Silicate	$MgSiO_3$	..	..	..	..	..	..	..
Ferric oxide		0.044	0.011	0.014	0.113	0.155	0.068	0.059
Total		39.565	8.076	10.216	47.110	28.579	16.040	4.215
Sodium Nitrate	$NaNO_3$	..	..	..	..	..	..	..
Sodium Chloride	$NaCl$	5.423	4.739	5.995	3.380	2.671	2.818	3.006
Sodium Sulphate	Na_2SO_4	1.157	10.822	13.030	5.449	38.528	0.000	3.156
Sodium Carbonate	Na_2CO_3	..	..	..	..	..	..	..
Sodium Bi-carbonate	$NaHCO_3$	..	..	..	..	..	..	..
Sodium Silicate	Na_2SiO_3							
Sodium Hydrate	$NaHO$							
Calcium Nitrate	$Ca(NO_3)_2$	..	..	..	..	..	..	..
Calcium Chloride	$CaCl_2$	..	..	..	..	..	..	..
Magnesium Nitrate	$Mg(NO_3)_2$	..	..	..	..	..	..	..
Magnesium Chloride	$MgCl_2$	..	..	..	..	..	0.238	0.000
Magnesium Sulphate	$MgSO_4$	..	..	..	1.204	0.000	..	..
Total		6.580	15.061	19.054	10.033	42.199	3.046	6.768
Total mineral matter		46.165	23.137	29.272	57.143	69.038	19.086	10.977
Alkalinity		22.061	3.642	4.608	15.54	25.410	13.701	3.847
Temporary hardness		22.061	2.642	4.606	15.54	25.410	13.701	3.847
Permanent hardness		12.500	3.332	4.216	25.34	2.572	2.419	0.467
Total hardness		35.251	6.874	8.882	40.88	27.982	16.120	4.314
Chemicals required in pounds per 1000 gallons.*								
Lime	CaO	2.106	0.000	..	2.25	1.59	1.563	0.408
Soda	Na_2CO_3	1.908	0.500	..	3.64	0.27	0.297	0.050
Cost per 1000 gallons	Pence	1.354	..	..	2.5	..	0.885	..

Chemicals, &c.	Chemical Symbols.	Doulton.		Harris-Anderson.		Lassen and Hjort. (1)		Lassen and Hjort. (2)	
		Supply.	Delivery.	Supply.	Delivery.	Supply.	Delivery.	Supply.	Delivery.
Grains per Gallon.									
Carbonic-acid gas	CO_2	4.78	0.00	8.856	0.000	6.84	1.39	10.000	1.67
Calcium Sulphate	$CaSO_4$	22.772	0.00	18.080	0.000	1.99	..	30.472	0.000
Calcium Carbonate	$CaCO_3$	12.805	0.814	} 6.53	1.938 {	14.701	1.009	5.588	0.311
Calcium Silicate	$CaSiO_3$	..	..			2.309	1.051	1.336	0.000
Magnesium Hydrate	$Mg(OH)_2$	..	..	0.291	0.000	..	..	..	..
Magnesium Carbonate	$MgCO_3$	0.000	1.898	9.177	3.835	0.000	0.365	13.110	2.841
Magnesium Silicate	$MgSiO_3$	..	..	..	..	..	..	..	0.308
Ferric oxide		0.147	0.112	0.214	0.111	0.017	0.091	0.067	0.047
Total		35.224	2.822	34.571	5.675	18.116	3.416	40.575	3.597
Sodium Nitrate	$NaNO_3$	0.004	25.932	..	..	..	..	..	..
Sodium Chloride	$NaCl$	8.238	10.756	23.971	23.971	1.145	3.161	4.686	8.987
Sodium Sulphate	Na_2SO_4	0.040	28.462	30.717	49.462	0.000	1.881	0.000	19.980
Sodium Carbonate	Na_2CO_3	0.060	13.921	0.000	0.671	..	..	..	..
Sodium Bi-carbonate	$NaHCO_3$	0.000	30.902	..	..	0.000	1.783	0.000	19.128
Sodium Silicate	Na_2SiO_3								
Sodium Hydrate	$NaHO$								
Calcium Nitrate	$Ca(NO_3)_2$	14.636	0.000						
Calcium Chloride	$CaCl_2$	..	..	..	..	0.707	0.000		
Magnesium Nitrate	$Mg(NO_3)_2$	9.350	0.000						
Magnesium Chloride	$MgCl_2$	1.177	0.000	..	..	0.808	0.000	2.961	0.000
Magnesium Sulphate	$MgSO_4$								
Total		33.421	107.572	54.688	74.104	2.035	6.885	7.547	47.995
Total mineral matter		68.645	110.394	89.259	79.679	21.671	10.261	48.122	51.592
Alkalinity		12.303	34.33	17.350	6.907	16.085	4.179	22.297	15.459
Temporary hardness		12.303	3.084	17.350	6.275	16.085	3.118	22.297	4.077
Permanent hardness		33.215	0.000	13.731	0.000	2.945	0.060	18.160	0.300
Total hardness		45.518	3.084	31.081	6.275	19.030	3.118	40.457	4.077
Chemicals required in pounds per 1000 gallons.*									
Lime	CaO	1.8	1.5	2.476	0.312	1.31	0.000	3.21	1.56
Soda	Na_2CO_3	6.0	-4.274	2.080	-0.098	0.44	-0.16	2.75	-1.09
Cost per 1000 gallons	Pence	3.11	..	1.475	..	0.4	..	1.965	..

* The minus sign (–) stands for excess.

The Tyake Water Softener.

Working.—The apparatus, Fig. 15, consists of a cylindrical settling tank with a central funnel and mixing tank. It has a sludge cock at the bottom. Above the funnel are two regulating tanks with ball taps; above them are two chemical tanks with floating discharge pipes. Only one tank is used at a time. Sufficient lime and water to produce clear lime water is put alternately into one of the two chemical tanks, the fluid is drawn off through a floating discharge, the quantity being regulated by a ball tap in a lower tank. The water to be treated is discharged into a similar tank with a ball tap, and the mixture passes to the bottom of a settling tank, and is drawn off at the surface. The apparatus has been in use since 1894.

Result of Chemical Analysis.—This apparatus was supplied with the hardest of the waters submitted, there being 55 deg. permanent hardness and 21 deg. temporary hardness. Unfortunately, far too little lime was added, so that the 18 grains of magnesium salts were hardly reduced at all. Only half the necessary quantity of soda was added, and the general result was most unsatisfactory. It is impossible to judge from this case how the apparatus would have behaved with less difficult water, and if the chemicals had been properly proportioned.

APPENDIX III.

CHEMICAL ANALYSIS—(*Continued*).

Chemicals, &c.	Chemical Symbols.	Maxim.			Porter-Clark.		Pulsometer.		Reisert.	
		Supply.	Delivery.	Delivery Less Steam.	Supply.	Delivery.	Supply.	Delivery.	Supply.	Delivery.
Grains per Gallon.										
Carbonic-acid gas	CO_2	6.33	5.07	..	5.08	0.43	5.54	0.00	6.68	0.000
Scale-forming constituents: Calcium Sulphate	$CaSO_4$	38.600	4.746	8.066	12.178	10.074	..	..	4.898	4.782
Calcium Carbonate	$CaCO_3$	0.000	10.149	12.988	8.071	0.000	5.183	1.551	10.423	1.496
Calcium Silicate	$CaSiO_3$	0.984	1.170	1.247	1.694	0.492	3.671	2.541	2.050	1.335
Magnesium Hydrate	$Mg(OH)_2$	..	..	..	..	..	0.000	0.376	0.000	0.294
Magnesium Carbonate	$MgCO_3$	12.032	15.333	16.340	0.109	0.928	4.270	0.000	1.453	0.000
Magnesium Silicate	$MgSiO_3$	..	..	..	..	..	..	..	..	0.737†
Ferric Oxide		0.367	0.112	0.110	0.248	0.057	0.947	0.034	0.251	0.054
Total		51.983	31.510	35.132	22.198	11.542	13.181	4.502	18.873	8.647
Non-scale-forming constituents: Sodium Nitrate	$NaNO_3$	..	..	..	0.000	12.994	..	..	0.109	9.247
Sodium Chloride	$NaCl$	129.790	117.06	124.740	5.068	5.578	10.586	11.037	3.750	3.773
Sodium Sulphate	Na_2SO_4	14.743	56.772	59.282	0.000	1.933	8.729	7.186	0.060	0.943
Sodium Carbonate	Na_2CO_3	..	..	..	..	..	0.000	3.484	..	..
Sodium Bicarbonate	$NaHCO_3$	..	..	..	..	..	7.296	0.094	..	..
Sodium Silicate	Na_2SiO_3	..	..	..	..	..	..	..	..	..
Sodium Hydrate	$NaHO$	..	..	..	..	..	0.080	2.158	..	..
Calcium Nitrate	$Ca(NO_3)_2$	..	..	..	..	..	..	..	5.098	0.000
Calcium Chloride	$CaCl_2$									
Magnesium Nitrate	$Mg(NO_3)_2$	..	..	..	12.399	1.621			..	..
Magnesium Chloride	$MgCl_2$	..	..	..	..	..	..	..	..	..
Magnesium Sulphate	$MgSO_4$	8.122	0.000	0.000	..	..	..	..		
Total		153.055	172.772	184.122	17.772	21.391	26.621	22.885	8.880	10.963
Total mineral matter		205.035	204.282	219.254	40.970	32.933	39.802	28.287	27.732	19.610
Alkalinity		15.129	29.346	31.276	11.432	1.512	17.780	10.336	13.910	3.501
Temporary hardness		15.128	29.346	31.276	11.432	1.512	13.416	4.379	13.910	3.501
Permanent hardness		35.128	3.490	3.719	17.248	8.498	0.000	0.000	6.502	4.424
Total hardness		50.256	32.836	34.995	28.68	10.01	13.416	4.379	20.412	7.925
Chemicals required in pounds per 1000 gallons.*										
Lime	CaO	2.834	2.486	..	1.093	0.253	1.412	-0.218	1.353	-0.105
Soda-Ash	Na_2CO_3	5.323	0.529	..	2.614	1.286	..	..	0.985	0.530
Cost per 1000 gallons	Pence	3.44	..	..	1.72	..	0.15	..	..	..

Chemicals, &c.	Chemical Symbols.	Stanhope.		Tyake.		Wollaston.			Wright.	
		Supply.	Delivery.	Supply.	Delivery.	Supply.	Delivery.	Delivery Less Steam.	Supply.	Delivery.
Grains per Gallon.										
Carbonic-acid gas	CO_2	5.70	0.32	9.29	4.93	6.21	0.00	..	3.408	0.050
Calcium Sulphate	$CaSO_4$	4.084	1.192	66.578	32.326	9.610	0.000	0.900	14.174	.
Calcium Carbonate	$CaCO_3$	1.259	0.518	7.649	0.60	5.592	0.355	0.471	2.033	0.162
Calcium Silicate	$CaSiO_3$	1.371	1.184	2.456	1.694	1.737	0.000	0.000	1.574	1.778
Magnesium Hydrate	$Mg(OH)_2$	..	..	..	..	0.000	0.171	0.227		
Magnesium Carbonate	$MgCO_3$	0.049	0.938	9.586	8.433	5.400	0.000	0.000	3.201	1.635
Magnesium Silicate	$MgSiO_3$									
Ferric Oxide		0.082	0.086	0.314	0.246	0.371	0.024	0.032	..	0.002
Total		6.845	3.866	56.583	42.909	22.710	0.550	0.730	20.982	3.577
Sodium Nitrate	$NaNO_3$									
Sodium Chloride	$NaCl$	1.443	2.801	19.415	20.806	7.593	8.013	10.635	1.351	3.897
Sodium Sulphate	Na_2SO_4	0.00	2.743	0.00	35.390	0.551	7.981	10.594	0.000	12.703
Sodium Carbonate	Na_2CO_3	..	..	..	..	0.000	13.702	18.183	0.000	6.142
Sodium Bicarbonate	$NaHCO_3$	..	..	..	..	..	..	..	0.000	4.630
Sodium Silicate	Na_2SiO_3	..	..	..	..	0.000	1.187	1.575		
Sodium Hydrate	$NaHO$	..	..	..	..	0.000	0.504	0.668		
Calcium Nitrate	$Ca(NO_3)_2$									
Calcium Chloride	$CaCl_2$									
Magnesium Nitrate	$Mg(NO_3)_2$									
Magnesium Chloride	$MgCl_2$	1.030	0.000	0.978	0.00	..	..	..	1.737	0.000
Magnesium Sulphate	$MgSO_4$	..	..	6.061	6.061					
Total		2.453	5.544	26.454	62.257	8.054	31.386	41.653	3.088	27.372
Total mineral matter		9.298	9.410	113.037	105.166	30.764	31.936	42.383	24.070	30.949
Alkalinity		13.830	2.656	21.130	11.648	13.403	15.161	20.121	7.184	12.173
Temporary hardness		13.830	2.656	21.130	11.648	13.493	0.650	0.862	7.184	3.625
Permanent hardness		4.063	0.867	55.008	28.802	7.065	0.000	0.000	12.246	0.000
Total hardness		17.893	3.523	76.147	40.450	20.558	0.650	0.862	19.430	3.625
Chemicals required in pounds per 1000 gallons.*										
Lime	CaO	1.127	0.146	3.087	2.100	1.641	excess of caustic soda – 1.661	..	1.069	0.625
Soda-Ash	Na_2CO_3	0.616	0.132	3.336	4.365	1.071		..	1.856	-1.295
Cost per 1000 gallons	Pence	0.49	..	5.24	..	0.806		..	1.205	

* The minus sign (–) stands for excess. † (Reisert delivery) calcium oxide, CaO.

The Wollaston Water Softener.

The apparatus, Fig. 16, consists of a settling tank and a reaction tank, surrounded by a feed heater with numerous trays. The inlet for the chemicals is at the bottom of this heater, from which a pipe, shown in dotted lines, leads to the bottom of the first reaction tank. An external overflow pipe leads from this tank to the bottom of the settling tank, which is provided with settling planes. The pump for the chemicals is actuated by the feed pump.

Capacity.—4,000 gallons per hour.

Dimensions.—Reaction tank, 3 feet 4 inches in diameter over angles. Settling tank, 5 feet 5 inches by 10 feet 5 inches; height, 13 feet. Feed heater, 2 feet 7 inches in diameter, 8 feet high. Floor space, 66 square feet.

About fifteen of these softeners, of various sizes, are in use.

Working.—The water is admitted at the top of the feed heater, exhaust steam which has passed through a grease separator being blown into the bottom. The descending water passes over several trays and then meets with a stream of soda solution, which completes the reaction initiated by the heat of the steam. The grease and precipitated lime adhere to each other and mutually increase their tendency to separate from the water. Most of the precipitate remains in the reaction tank, and only a small quantity is carried into the settling tank. No filter was used.

Supply.—Well water.

Chemicals used.—Caustic soda—quantity not stated.

The users report that the effect on the boiler is satisfactory, except that old scale is not loosened. With recent installations, in which there is no excess of alkalinity, the old scale is rapidly coming away, even from within the Makin boiler cones.

Result of Chemical Analysis.—The analysis shows that about 33 per cent of condensed steam was added to the supply, which has to be subtracted from the delivery. This has been done in the third column of the Table of Analysis herewith, where it will be seen that a total hardness of 20.5 deg. had been reduced to 0.86 deg., but the alkalinity of the treated water is so high, due to 18 grains of carbonate of soda, that one might expect that the concentrated boiler water would attack the brass fittings. The users make no complaint on this subject. At these works waste caustic soda from the mercerizers was available, of which an excess of 2 pounds per 1,000 gallons was used. It would have been better to use only 0.809 pound of caustic soda and 1.076 pound of lime. The lime would have dealt with 13 deg. of temporary hardness, and the caustic soda, after combining with the carbonic acids, would have dealt with the permanent hardness, and practically no carbonate of soda would have been found in the delivery.

The Wright Water Softener.

The apparatus, Fig. 17, consists of a rectangular settling tank, filter, mixing tank, and lime tank combined, surmounted by a distributor. At the side of the lime tank is a lime-slaking tank and a soda tank, not shown. The settling tank has a large number of 6-inch baffle plates, inclined at an angle of 45 deg., on which the mud settles and slips down. Above these baffles is a filter, and at the discharge level is a float attached to a leather hose in the distributor, which causes the two water levels to rise and fall together. Another float in the distributor regulates the supply of unsoftened water. This arrangement has been superseded. The distributor has a weir with two adjustable overflows to the mixing tank and lime tank. A mixing chain reaches to the bottom of the lime tank and a small bucket chain draws from the soda tank. These chains are actuated by a water wheel.

Capacity.—10,000 gallons per hour, but only worked up to 5,000 gallons.

Dimensions.—Combined tank, not including lime-slaking tank and platform, 6 feet 5 inches wide, 13 feet 6 inches long, 23 feet high. In addition there are two cylindrical settling tanks, not shown, 7 feet 6 inches in diameter, and 27 feet high. Floor space of apparatus, 86 square feet; ditto, including two tanks, 112 square feet.

This firm also make water softeners in which exhaust steam is utilized.

Working.—The untreated water flows over a weir, one part descending over a water wheel direct into the mixing tank, the other part passing to the bottom of the lime tower, forcing the same quantity of clear lime water into the mixing tank. A small, but definite, quantity of soda solution is also tipped into the mixing tank, the bucket chain being actuated by the water wheel. From the bottom of the mixing tank the mixed water passes up through the settling tank, most of the mud settling on the large number of baffles and slipping down. It is now and then removed through the sludge-cock. The mud which gets arrested at the bot-

tom side of the filter is easily washed into the settling tank by opening the sludge cock.

The users report that the boilers are fed partly by softened and partly by unsoftened water, and the effect on the boilers has not been noted. The baffle plates were cleaned twice in twelve years. Half the filter stockings are changed every day. The mud is easily run off. There used to be a deposit in the pipes; now two boiler shells, 27 feet high by 7 feet 6 inches in diameter, are used as extra settling tanks.

Results of Chemical Analysis.—The water treated by this apparatus presented no serious difficulties; but here again the mistake was made of adding too little lime and too much soda; and although the delivery is fairly soft, its alkalinity is rather high.

APPENDIX IV.

Instructions for Controlling Chemical Treatment.

Chemicals Required.—Standard soap solution, Wanklyn's strength (1 cm³* = 0.001 gr. $CaCo_3$) standard N/50 acid solution (1 cm³ = 0.001 gr. $CaCO_3$) standard N/50 sodium carbonate solution, must be free from bicarbonate. Powdered ammonium oxalate crystals, methyl orange, and phenol-phthalein indicators.

Apparatus.—Three 50 cubic centimeter burettes graduated to 1-10 cubic centimeter. Three 8-ounce glass stoppered bottles, funnel and filter papers; two white porcelain basins, 4½ inches in diameter, and one 70 cubic centimeter pipette.

I.—70 cubic centimeters of the water are placed in a clean bottle, and the soap solution run in in small quantities at a time, and the bottle vigorously shaken after each addition. As soon as lather appears, lay the bottle on its side, and observe if the lather persists for five minutes. When this is the case, read off the quantity of soap solution used and, because of some uncombined soap in the lather, subtract 1 cubic centimeter; the remainder is the total hardness A. When the water requires more than 16 cubic centimeters of soap solution, it must be diluted with 70 cubic centimeters of distilled water, and 2 cubic centimeters must be subtracted from the reading.

II.—Take about 120 cubic centimeters of the water, add about 4 grains of ammonium oxalate, shake, and let it stand for ¼ hour; filter, testing the filtrate with ammonium oxalate to insure complete precipitation, and take 70 cubic centimeters of this filtrated water and conduct the soap test as before. The reading less 1 cubic centimeter is the reduced hardness B.

III.—70 cubic centimeters of the water are placed in a porcelain basin, one drop of the methyl orange indicator added, and standard acid dropped in from the burette until the yellow tint just changes to rose pink. Read off the alkalinity (sometimes called temporary hardness), C.

IV.—70 cubic centimeters of the water are placed in a porcelain basin and 3 or 4 drops of phenol phthalein added. If the water is acid, it remains milky (generally so with natural waters). In this case (1) add the standard sodium carbonate until a pale persistent pink color is obtained. Read off the phenol phthalein acidity, D.

The water—especially softened water—may turn the phenol phthalein pink.

In this case (2) the 70 cubic centimeters are titrated with the standard acid until the pink color is almost destroyed. Read off the phenol phthalein alkalinity, E.

Tests on Hard Water.—Reagents required in pounds for softening 1,000 gallons:

Soda Ash.—0.15 (A — 1-3 B — C) pound.

Lime.—Case IV. (1). (Water is acid to phenol phthalein.) 0.085 (2-3 B + C + D) pound.

Lime.—Case IV. (2). (Water is alkaline to phenol phthalein.) 0.085 (2-3 B + C — 2 E) pound.

Using these values, the ratio of lime water to total supply is $\frac{\text{Lime}}{13 + \text{Lime}}$.

Tests on the Softened Water.—If an excess of soda ash has been added, the amount in excess—0.15 (A — 1-3 B — C) pound—is negative.

When too little soda ash has been added, the insufficiency is 0.15 (A — 1-3 B — C) pound, as in the untreated water.

If too much lime has been added, the amount in excess is 0.085 (2 C — 2 E — 2-3 B) pound.

If too little lime has been added, the insufficiency is 0.085 (2-3 B + C — D) pound, as in the untreated water.

FERTILIZERS FROM FISH WASTE OR REFUSE.†

By CHARLES H. STEVENSON.

EVEN in the food fisheries large quantities of materials are obtained which cannot be used for food. This includes not only non-edible species, but also those edible varieties which are not marketable, owing to such unusual conditions as lack of transportation facilities or a glut in the market. It likewise includes the refuse in dressing fish for the markets and for canning, drying, salting, etc.

Formerly, when the markets were overstocked during warm weather, large quantities of fresh fish spoiled and were suitable only for fertilizer. Even so choice a variety as the mackerel has been used for enriching land when taken in larger quantities than could be used for food purposes. In 1880, for instance, when the total catch of mackerel in New England approximated 132,000,000 pounds, 500,000 pounds of small fish were reported as having been used in Massachusetts as fertilizer.*

Previous to 1870, according to Capt. N. B. Church, many thousand barrels of scup and sea bass, taken in trap nets between Cape Cod and Montauk Point, were purchased by farmers and spread on the land. Mr. A. B Alexander states that large quantities of shad taken in the Columbia River are used for fertilizer. With the development of fish freezers and the improved means of communication and transportation this waste is much reduced. Yet the aggregate quantity of food fish received in bad condition, or which "goes bad" in the markets, in the course of the year, is very large in any populous city. During 1899, according to the Fish Trades Gazette, the quantity of fish condemned by the officers of the Fishmongers' Company in London was 1,520 tons, of which 232 tons were plaice, 228 tons Norwegian herring, 169 tons haddock, 94 tons mussels, 80 tons skate, 70 tons whelks, and 60 tons of periwinkles. In New York city the quantity of spoiled fish condemned during the summer amounts to several hundred thousand pounds each year.†

Before the development of the sardine industry in Maine, the small fish taken in connection with the smoked herring business were commonly converted into oil and fertilizer. After the oil had been extracted by boiling and pressing, the chum was broken up, spread on a board platform, and dried by the action of the sun. It was then ground, bagged, and sold at $12 to $16 per ton.

About fifteen years ago a factory was established at Pillar Point, on the shore of Lake Ontario, for converting the surplus alewives occurring in that lake into fertilizer. The fish, obtained by means of seines and pound nets, were cooked for about 20 minutes in steam chests, permitted to drain for an hour, and then subjected to pressure in circular curbs holding about five barrels of chum each. The scrap was dried and ground and sold to the farmers for about $20 to $25 per ton. It is reported that in 1886 1,000,000 fish were utilized, yielding 500 gallons of oil and 63 tons of fertilizer. Along the shores of the Great Lakes and other waters, quantities of dead fish have been washed up in windrows, furnishing a harvest for the farmers in the vicinity.

In the pound-net fisheries of Cape Cod many skates and other "poor" fish, taken incidentally with the food fish, are converted into fertilizer. If these contain much oil, it may be extracted by boiling and pressing. Ordinarily, however, the fish are dried without previous treatment. Especially is this the case with skates, which in some instances are suspended in rows above the ground until thoroughly dry, and are then ground fine. A large quantity of these fish hanging from a series of flakes or rails presents a very curious sight.

The quantity of waste and spoiled fish, however, is small compared with the very large amount of viscera and other offal resulting from dressing fish. The decrease in weight in dressing ranges from 15 to 35 per cent of the round weight, according to the species of fish and the season of the year. Assuming an average decrease of 25 per cent, it appears that in dressing the 900,000,000 pounds of food fish produced in the United States each year the refuse amounts to 225,000,000 pounds, or 112,500 tons. While this is a very large amount in the aggregate, it is so widely distributed that the quantity at any one place is not of great importance, and usually its disposal is a sanitary problem rather than a source of revenue. In dressing fish at sea the waste is almost invariably thrown overboard. In the cities this material is usually combined with and handled in the same way as other market refuse. At the canneries where large quantities of fish are dressed, as in the salmon canneries of the Pacific coast, and the sardine canneries of Maine, the refuse is now in many cases rendered into oil and fertilizer.

In case the fish dressings contain little oil the inducements for utilizing them are not great. Water constitutes a very large proportion of the viscera, the quantity ranging from 65 to 90 per cent, according to the species and the season. Even when the moisture is largely removed the quantity of fertilizing substances in the dried material is small. However, if the quantity of oil in the waste is sufficient to pay the cost of its extraction, it is usually profitable to perform the slight additional labor necessary to make the material suitable for fertilizer. The manurial content of fish heads is relatively large, and whenever they are accumulated in large quantities their conversion into fertilizer is profitable.

A convenient process of converting a small quantity of refuse from dressing fish into fertilizer is to store it in a receptacle made in the ground. This should be about 5 or 6 feet deep, with the area depending on the amount of refuse, but usually about 6 feet square. It should be dry, and if the soil is sandy some clay should be spread at the bottom. First is placed a layer of wood ashes a few inches deep and then an equal layer of fish refuse covered by a sprinkling of lime. Then follow another layer of ashes, one of fish refuse sprinkled with lime, and so on until the hole is full. It should be covered with earth or sod and these covered with weighted boards and permitted to so remain for several months. The fish refuse quickly disintegrates and becomes mixed with the ashes, forming an excellent fertilizer.

Since 1875 the skins and bones resulting from the preparation of boneless codfish have been used for fertilizing purposes. After desalting them and extracting the glue, the remaining material is dried and sold for $15 or $20 per ton. The annual product amounts to about 3,000 tons. Most of this is produced at Gloucester, Mass., with smaller quantities at Boston, Provincetown, Portland, and Vinal Haven. According to analyses, this fertilizer contains about 10 or 12 per cent of phosphoric acid, 8 or 9 per cent of nitrogen, and 5 or 6 per cent of moisture.

The refuse in preparing oil from livers of cod, sharks, and related species, from heads of halibut, sturgeon, and swordfish, and from other materials is also dried and sold for fertilizer. The liver scrap formerly sold at $8 or $10 per ton, but at present its market value is only about half of that amount. Fertilizer made from fish heads is especially rich in phosphoric acid. A sample of guano made in Boston from fresh cod heads showed 20 per cent of phosphoric acid, 6½ per cent of nitrogen, and 3½ per cent of moisture, and a sample of that made from fresh halibut heads contained 13 per cent of phosphoric acid, 5 1-3 per cent of nitrogen, and 5 per cent of moisture.

An important fish fertilizer in Norway is made from the refuse in dressing cod for drying, consisting principally of heads and backbones. These are merely dried by spreading them on the rocks and are then broken and ground to the condition of coarse bonemeal. In some localities the refuse is first steamed, to facilitate the drying and grinding. The utilization of these materials for fertilizer was begun about 1855, and the industry is centered at the Lofoden Islands, the location of the principal cod fishery of Europe. The present annual production is said to be upward of 10,000 tons of prepared scrap, about 20,000,000 cod heads being utilized for the purpose.

According to a report made by Consul-General Crowe, of the British service, the heads and bones are first partly dried in the open air and then cut into small pieces and thoroughly dried in a kiln. When all but 12 or 15 per cent of moisture has been driven off, the materials are crushed and then ground between millstones to the fineness of corn meal. The heads and bones are crushed separately, but are mixed together before the grinding process, the usual proportion of the mixture being one part of the backbones to five parts of the heads. Chemical analyses indicate an average content of water 13 per cent; organic substances 49.3 per cent, of which 8 per cent is nitrogen and 7.6 per cent ammonia; and inorganic substances 37.7 per cent, of which 14.9 per cent is phosphoric acid.

In utilizing whales at the Norwegian stations established in connection with the taking of these cetaceans, the flesh and bones are commonly prepared as fertilizer after the extraction of the oil. The blubber and the fat-lean are first removed from the flesh for oil rendering, and then the flesh is cut into strips or minced in a machine and boiled with steam under pressure. As described by Michael Winnem, in Chemische Revue, the receptacles for boiling the flesh are horizontal iron cylinders provided with close fitting openings. They are also provided with two outlet pipes, one at the very bottom, for removing the water, and the other about 4 inches higher up, for drawing off the oil. The flesh is spread on three superimposed perforated trays or false bottoms, and subjected within the cylinder to steam at a pressure of 40 or 50 pounds to the square inch for ten or twelve hours. At the end of that period the flesh is removed and placed in drying ovens. These are built of brick, 20 to 25 feet high, and fitted with internal sheet metal trays, which are mounted alternately on the sides of the oven and on a central revolving shaft. The latter carries a number of slanting scrapers which revolve once in 5 minutes and slowly force the flesh from one tray to the next lower ones in succession. The descending flesh is dried by the heated air from a coke fire, which enters the oven at the top and passes out through an opening at the bottom.

The process is somewhat slow, the output during twenty-four hours not exceeding 2 tons for each oven. If desired, the fertilizer may be ground in a mill. The bones are broken and treated in much the same manner as the flesh. After boiling they are crushed in a disintegrator, ground in a bone mill, and mixed with the flesh scrap. An analysis made by Krocker of Norwegian whale fertilizer indicated 7.63 per cent of nitrogen, 13.45 per cent of phosphoric acid, 14.69 per cent of lime, and 0.15 per cent of magnesia in a sample containing 5.35 per cent of moisture. The market price is about £5 per ton. In the bottle-nose fishery the oil is commonly extracted at sea, as in case of the American whale fishery, and consequently it is not practicable to utilize the flesh and bones as fertilizer.

Gilding with the Brush or with Ormolu.—This not very strong gilding can only be performed on small surfaces and is used for "touching up" small defects in a finished article which are not serious enough to render re-gilding necessary. The process is performed by means of bronze-gold powder, which is sold in all colors. It is cheaper to buy it ready made than to prepare it. The powder is mixed with some colorless spirit-varnish and spread over the defective part with a thin brush, the object being afterward warmed in a drying-stove or by a charcoal fire. Every gilder should have a complete assortment of these powders on hand; their use will often save him much trouble.—Der Metallarbeiter.

* cm³ is used instead of c.c., in conformity with the arrangement recommended (Proceedings, 1900, June, page 394).

† From United States Fish Commission Report of 190?

* Report U. S. Fish Commission, 1881, p. 219.

† During the interval between Wednesday, June 30, and Wednesday, July 14, the authorities of the health department of New York city condemned as unfit for food, 41,650 pounds of fish. Of this amount, 39,650 pounds were seized in the Fulton Fish Market, the remaining 2,000 pounds being condemned by the local inspectors among the retail dealers in various sections of the city. (The Fishing Gazette, 1902, p. 458.)

A COSTUMED HUMAN FIGURE FROM TAMPICO, WASHINGTON.*

By HARLAN I. SMITH.

THE following is a description of a remarkable specimen (Fig. 3), secured June 16, 1903, by the writer while making an archæological reconnoissance of the Yakima Valley for the American Museum of Natural History. It is made of antler, is 247 millimeters long, from 2 to 5 millimeters thick, and is engraved on one surface to represent a human figure in costume. This specimen was found in the grave of a child about six years old, which was situated near Tampico, in the Atanum Valley, Yakima County, Washington. The place is about eighteen miles west of old Yakima.

FIG. 1.—A GRAVE IN A KNOLL SURROUNDED BY "SCAB LAND" NEAR TAMPICO, WASHINGTON.

The hill to the right marks the western end of the desert and the beginning of the timbered land.

FIG. 2.—GRAVE IN WHICH TAMPICO SPECIMEN WAS FOUND.

Stone cist in opened grave.

In this arid region are stretches of country locally known as "scab land," on which are occasionally groups of low dome-shaped knolls from about 50 to 100 feet in diameter by three to six feet in height. These knolls consist of fine volcanic ash, and apparently have been heaped together by the wind. The prehistoric Indians of this region have used many of these knolls, each as a site for a single grave. These graves, which are located in the tops of the knolls, are usually marked by large river pebbles, or, in some cases, by fragments of basalt, that appear as a circular pavement projecting slightly above the surface of the soil. (See Fig. 1.)

The particular grave in which this specimen was found was indicated by irregular and jagged basaltic rocks which formed a pile, about 8 feet in diameter, on top of an ash dome, located on the bottomland about 600 feet north of the Atanum River, and about 15 feet above the water-level.

These jagged rocks and the soil which had accumulated between them extended down to a depth of three feet from the surface, where a box or cist was found, which was formed of thin slabs of basaltic rock about 2 feet long by 1½ feet wide, and from 1½ to 2 inches thick, with thin, sharp edges. These had been placed on edge—several to form the sides and one or two to form the ends. The cist thus made was covered with two large flat slabs which projected beyond the sides of the box. (Fig. 2.) There were no slabs or other rocks forming the floor to the cist, which was filled with soil that had worked in between the stones.

This was the only grave in which we found a stone cist, the other graves being more or less filled, from the skeleton to the surface, with irregular rocks or pebbles.

This cist may be perhaps best described by stating that it resembled very much the stone graves of Kentucky and Ohio, excepting that limestone was not here used and that the position of the skeleton and the character of the objects found within were not similar to those usually observed in the stone graves of the Mississippi Valley. It is also to be noted that here we have a pile of jagged rocks over the cist, as is seldom the case in the East.

Within the box and about on a level with the lower edges of the inclosing slabs was the skeleton of the child. It lay upon the left side, the head toward the west, facing north, and with the knees flexed close to the chest. The skull is slightly deformed by occipital pressure. Under the body, scattered from the neck to the pelvis, were found eighteen dentalium shells. Ten of these are ornamented with engraved designs and resemble the engraved dentalium shells found in the Thompson River region. A small piece of bone and some charcoal were also found in this grave.

The grave and the specimens that were found in it seem to antedate the advent of the white race in this region, or at least to show no European influence. On the other hand, there was no positive evidence of their great antiquity.

The antler figure lay horizontally under the vertebræ of the child, with the engraved surface up. As the costume is apparently a man's, it would seem that the child had been of that sex. An ear-shaped projection may be noted on each side of the head-dress, too far from the head to indicate the ears, which apparently are omitted. These projections are perforated with two holes, and were probably intended to fasten the figure to something or as places of attachment for decorative or symbolic objects, such as feathers. Below the nose are faint suggestions of an ornament. The eyes are of the shape of a parallelogram with rounded corners. These, with similarly shaped figures on the head-dress or inner hair-rolls, and on the hands, knees, and insteps, slightly resemble a motive common in the art of the coast to the northwest.

FIG. 3.—FIGURE MADE OF ANTLER.

From a child's grave near Tampico, Washington. Half natural size.

Above the face is a zigzag line which may represent tattooing, painting, or a head-ring. The zigzag is a common form of decoration on the head-bands of the Sioux. Above the head, arranged in a semicircular row, are certain oblong forms which may indicate feathers. The middle form in this row, however, is marked with a circle. At both the bottom and top of this row are three incised lines forming an arc. Based on the outer one of these incisions are isosceles triangles slightly in relief. These do not represent feathers in a realistic way, but closely resemble the conventional paintings made by the Sioux on buffalo robes. These paintings have been called sun symbols, but are interpreted by the Sioux as the feathers of a war bonnet or other head-dress. Paintings or tattooings, representing the ribs, or the ribs themselves, are indicated by ridges. A bracelet, band, or figure painted or tattooed on the apparently bare arm is indicated in the middle of each by vertical hachure connecting pairs of parallel lines.

* Abstracted from the Bulletin of the American Museum of Natural History, Vol. xx, Article xvi, pp. 195-203.

The legs begin at the bottom of the apron, from which they are set off by two horizontal incisions. The incisions on the legs probably represent painting or tattooing, since the designs seem to be horizontal and to extend all around the legs, while on leggings the patterns are usually vertical and on a flap at the outer side of the leg, the knee being disregarded. Catlin figures paintings on the arms and legs of the Mandans similar to the patterns on this carving. The custom is not rare, especially in connection with elaborate ceremonial costumes such as are represented by this figure. The concentric design probably is related to the wheel, sun, or spider-web pattern common as a symbol on the shirts, blankets, and tents of the Plains tribes.

FIG. 4.—PAINTINGS ON BASALTIC CLIFFS AT THE WEST OF THE MOUTH OF COWICHE CREEK, WASHINGTON.

White representations of human heads with feather head-dresses.

The two feet, taken together with the lower portion of the legs, resemble a divided hoof. The divided hoof is a common design among Plains tribes. The vertical incisions on the feet probably represent the toes, or designs painted or tattooed on the feet. These lines argue against any idea that the feet are incased in moccasins, unless bead or quill work on or improbable wrinkles in the moccasins are indicated by them. The reverse of the object is plain.

The Indians of this region have painted with red and white on the basaltic cliffs in various parts of the Yakima Valley. Many of these paintings represent human heads, and some of them the whole figure. All of these are represented with a feather head-dress. Those shown in Fig. 4 are on the south side of the Natches River at the west of the mouth of Cowiche Creek and only fourteen miles from Tampico.

Similar heads and figures, each with a feather head-dress, are represented by lines pecked into the surface of the basaltic columns on the eastern side of the Columbia River at Sentinel Bluffs. These are only forty-seven miles from Tampico, and are shown in Figs. 7 and 8.

In general the shape of both the painted and pecked full figures resembles that of this specimen and the one shown in Fig. 6.

There are only two specimens, of which I am aware, that resemble this. One consists of seven fragments of a thin piece of antler found by Mrs. James Terry at Umatilla, Oregon, only about 83 miles in a southerly direction from Tampico. Below the chin, at the left, are four incisions in a raised piece. This seems to represent a hand held

FIG. 5.—FRAGMENTS OF A FIGURE MADE OF ANTLER.

From Umatilla, Oregon, collected by Mrs. James Terry Half natural size.

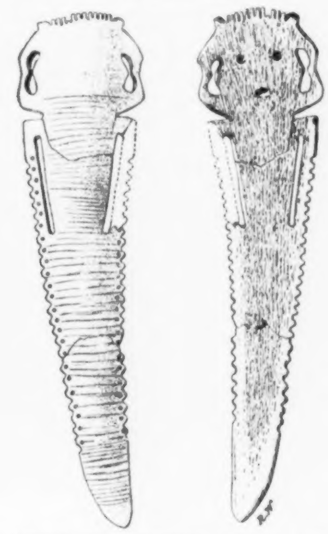
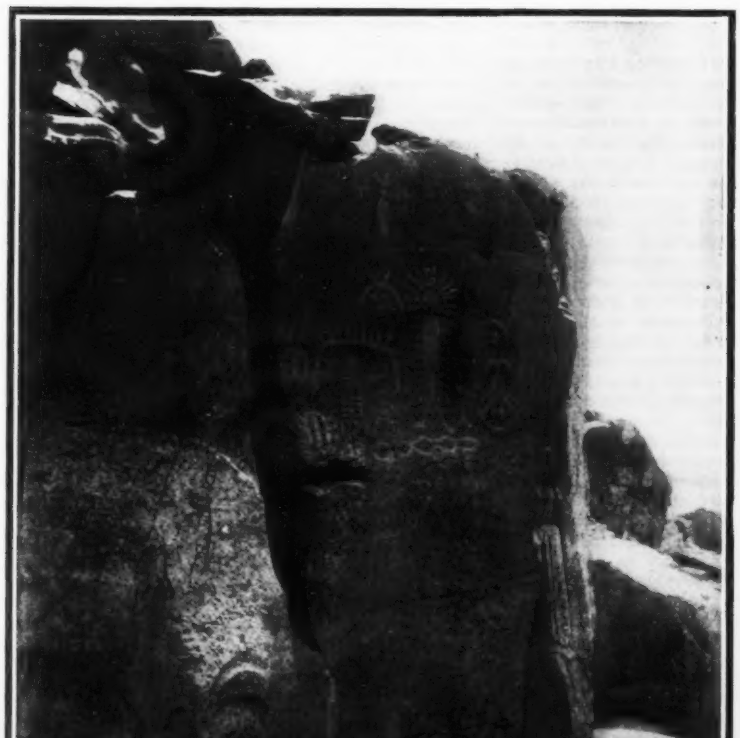
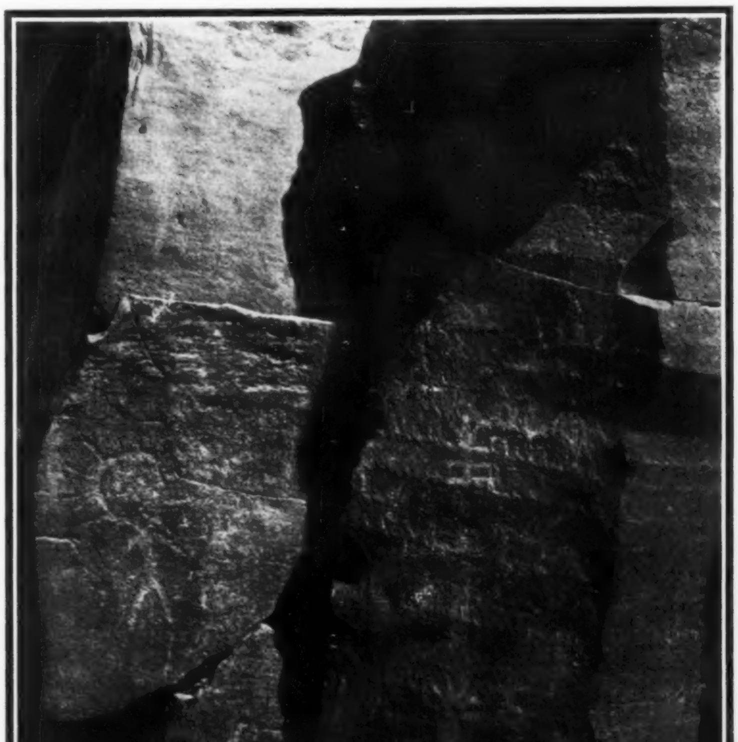


FIG. 6.—QUILL-FLATTENER MADE OF ANTLER.

From the Dakota at Pine Ridge, South Dakota, collected by Dr. Clark Wissler. Quarter natural size.

with the fingers to the neck. A foot, with four toes in relief projecting above the brow as high as do the eyebrows, rests immediately above the upper horizontal incision and apparently indicates that some animal, possibly a bird, stood upon the human head. The fragment, however, is not sufficiently large to settle these points. Two of the other fragments are apparently intended to represent the heads of dogs. The eyes are indicated by the common circle and dot design; while the nostrils in one are represented by drilled dots. The animal heads and the feet and hands suggest the possibility that in some cases animal forms were com-





FIGS. 7 AND 8.—PICTURES, SOME OF THEM REPRESENTING HUMAN HEADS AND WHOLE FIGURES, EACH WITH A FEATHER HEAD-DRESS, PECKED IN BASALTIC COLUMNS AT SENTINEL BLUFFS, WASHINGTON.

Fig. 7. Fig. 8.

bined with such figures, as on the Northwest coast, although the general style of art of the object is not like Haida or Kwakiutl work, but more like the carvings of Puget Sound and the lower Columbia River. The fact that the carving of this face is more in relief helps to explain the intent of the author of the Tampico specimen.

The other specimen is a quill-flattener, made of antler (Fig. 6). It was obtained by Dr. Clark Wissler from the Dakota at Pine Ridge, South Dakota, who also made reference to other objects of the same sort among the tribe. Porcupine quills were flattened on it with the thumb-nail. The object in general resembles in shape and size the specimen from Tampico. The slight indications of the hair or head-dress, the deeply cut eyes and mouth in the concave side, the holes or ears at the sides of the head, and the method of indicating the arms by slits, setting them off from the body, are all details which emphasize this general resemblance. The technical work is about as good as that of the Tampico specimen, but the art work is inferior. On the surface are twenty-six horizontal incisions, which were interpreted as year counts. The general shape of the body and the rows of dots are similar to those of the figure pecked on the cliff at Sentinel Bluffs. (See Fig. 7.)

The Tampico specimen may have developed from a quill-flattener, which implement was probably of common and characteristic use among Indian mothers, not only of the plains, but also as far west as Tampico. If the result of such a development, it had probably lost its domestic use and become entirely symbolic.

The head-dress seems to be a so-called war bonnet, and would indicate that the figure was that of an important personage; perhaps a suggestion of what had been hoped for the child's position in the tribe or after death. The arms, body, legs, and feet are apparently bare and ornamented with ceremonial paintings, while about the waist is an apron. The whole object seems of a rather high order of art to be a mere child's doll, and it would seem more plausible to consider it as an emblematical figure. The general style of art and costume indicated show little or no resemblance to those of the Northwest coast, but a strong relationship to those of the plains.

ELECTROCULTURE.*

A fact which is both interesting and encouraging has for some time been remarked in Europe, and that is the change that has occurred, after several years of somnolence, in favor of the application of electricity to agriculture, not only for the actuating of all kinds of farm machines, but also for quickening the vegetation of plants and the germination of seeds. In France, the Minister of Agriculture quite recently sent to the prefects and subprefects a circular giving instructions for in every way facilitating the application of electricity to the rural districts, and setting forth the advantages to be derived therefrom by agriculture and the industries in general. It must be admitted that our contributor, M. Guarini, has greatly aided this movement by his numerous articles and lectures upon the subject. In Belgium, matters are in a still more advanced state, since the interesting question of electricity in agriculture has been introduced into the curriculum of universities.

The Minister of Agriculture has found the subject sufficiently interesting to commission M. Guarini to develop it, at the Agricultural Institute of Gembloux, in a course of lectures embracing the subjects mentioned further along. The first and second lectures have already been delivered. The second of these, in which M. Guarini elucidates the interesting question of electroculture, merits special notice.

We cannot dwell upon a description of the numerous experiments made and the numerous apparatus employed, nor upon the contradictory results obtained by experimenters in different countries. As regards the latter, they may be summed up in the statement that the products obtained by electroculture are more abundant, come in earlier, and are finer than those obtained in the natural way. On the contrary, we shall speak at some length of the new and original ideas put forth by M. Guarini, and also of his theoretical attempt to explain, chemically and mechanically, the valuable results that are obtained by applying electricity to vegetation.

During the last forty years, especially since the time of the German Sachs, our ideas concerning vegetable physiology have become very clear. At present, we very easily explain the function of every plant organ, its *raison d'etre*, and its form. We cannot, remarks M. Guarini, say as much concerning pine needles and especially the awns of the cereals. On the other hand, we know many things concerning the function of chlorophyl and especially of what it consists—and what is required to stimulate it and render it more active. But, on the contrary, we are entirely in the dark as to how carbonic acid is decomposed in the chlorophyl into carbon and oxygen.

Here M. Guarini asks whether, in our time, when so many things are explained by electric phenomena, and when earthquakes and auroræ boreales are explained in the same way, and when we know that heat and light are electro-magnetic vibrations of the ether, we are not authorized in believing that the life of the plant also is based upon an electric phenomenon. He thinks that it is, and demonstrates it to be so. In the first place, he remarks that the awns of the flower glumes of cereals and the needles of conifers serve to absorb and disperse electricity. In the second place, he says that, contrary to what is believed and taught, it is not electricity that in certain cases is capable of acting as a substitute for light in the accomplishment of the chlorophyl function, but it is the light of the sun or of arc lamps which is able to do the work of electricity. The best proof of this fact is found in the following experiment: A plant placed in a pot and inclosed in a metallic cage (Faraday's) will die, although exposed to the sun, because, says M. Guarini, it is withdrawn from the *indispensable* influence of atmospheric electricity and especially of the electric radiations of the sun. On the contrary, if a plant is in absolute darkness, it is capable of yielding much finer, earlier, and more abundant products, provided a judicious electric treatment be applied to it. Apropos of the experiment with the Faraday cage, M. Guarini remarks that in order that the plant shall die, it must be in a pot completely surrounded by the metallic cage. When, in fact, it is in the ground, the influence of the solar electric radiations and of the current which passes from the atmosphere to the ground, but not that which passes from the latter to the atmosphere, will have been completely abolished every time that the potential of the earth changes from its habitual negative to positive, as when, for example, it rains, hails, or snows.

When a plant is put in the ground and surrounded with a metallic cage, it does not, in fact, die completely, but, as the experiments of Grandeau and Leclerc have proved, there is a diminution of from 50 to 70 per cent in the leaves and stems and of from 50 to 60 in the seeds and fruit, which does not occur when the cage does not exist.

After this indispensable preamble, M. Guarini explains the influence of electricity upon the principal vital functions of the plant, that is to say, nutrition, respiration, and transpiration.

NUTRITION.

(1.) *Aerial Nutrition.*—The current that passes through the plant from the atmosphere to the ground, or *vice versa*, decomposes the carbonic acid in the chlorophyl into carbon and oxygen. M. Guarini tried the following experiment: He injected carbonic acid into a vessel of water in which were two electrodes connected with a 110-volt current, when there at once formed a deposit of carbon at one of the electrodes. He states that, in conjunction with Dr. Samarani, of the Agricultural Institute of Gembloux, he has obtained formic aldehyde. For this purpose, special conditions of voltage and amperage are requisite. All this, says M. Guarini, is in perfect accordance with the experimental results obtained by Walther in his experiments on the synthesis of sugars by electrolysis, and in which the raw material was decomposed by carbonic acid.

(2.) *Nutrition in the Soil.*—The natural currents that traverse the ground (telluric currents) or artificial ones (from batteries, accumulators, dynamos, etc.) decompose the chemical products that exist therein and that have been added thereto and form others more assimilable by plants.

(3.) *Distribution of Aliments.*—There is something material in the electric current. When a current is interrupted and the tension is sufficient, there occurs a passage of gas from the positive to the negative pole. In arc lamps on the one hand and electrolysis on the other, there is a transfer of matter from the positive to the negative pole. M. Guarini recalls the experiments of Prof. Heamstropf, of the University of Elsingford, who caused water to rise in a capillary tube placed in a bowl in which was also plunged the positive pole of a static machine, the negative pole being connected with the top of the capillary tube. When, therefore, the potential of the earth is positive, or is made so artificially, and the potential of the atmosphere becomes negative over the plants, the current that goes from the ground to the atmosphere carries along with it the water and nutritive substances, that is to say, quickens the circulation of the sap.

RESPIRATION.

This consists in causing oxygen to enter through the pores of the capillary vessels. When a current passes from the atmosphere to the ground, oxygen is carried in the direction of the current, that is to say, from top to bottom of the plant, and is driven with more or less force into the pores, thus accelerating respiration.

TRANSPIRATION.

This consists in driving out of the plant the gases of combustion, carbonic acid, and water vapor. When a current traverses a plant from bottom to top, the opposite of respiration occurs, and the gases of combustion are driven out of the pores. To all these chemical and mechanical effects must be added another and quite important one. Prof. Lemström has proved that when an electric current of high tension is applied to plants, there occurs a production of ozone in large quantity, nitric acid, nitrous acid, and (perhaps) ammonia. Now, we know that the nascent oxygen of ozone is very active, as is proved by the remarkable greenness of plants after a storm. It results from this, says M. Guarini, that, for respiration, it is necessary that the plant shall be traversed by a current going toward the ground, and that for transpiration it shall be traversed by one going toward the atmosphere, while for nutrition the direction of the current is of no importance. Since nutrition and respiration are the two most important functions of plant life (transpiration being the consequence of it), the best result is obtained when the plant is traversed by a current going toward the ground, and this would correspond to the normal electric state of the atmosphere and earth. In order to prove that experiment is in accord with theory, M. Guarini projected upon the screen a slide from a negative obtained by Prof. Lemström in the experiments that he made with a static machine of his invention. In this picture it was possible to see and compare the results obtained with carrots that had been submitted to an atmosphere which had been electrified positively, negatively, and not at all. When the atmosphere was electrified negatively, the carrots were better than when there was no electric treatment. In this case, as we have said, there was a quickening of the nutrition and transpiration. The results are incomparably better when the atmosphere is electrified positively, that is to say, when we have a current that goes toward the earth. In this case not only are the nutrition and respiration quickened, but, what is more important, a larger quantity of carbonic acid is forced into the plant, that is to say, a larger quantity of nutriment. The pictures shown by M. Guarini proved in addition that the results are deplorable when both kinds of currents are applied.

M. Guarini remarks that in order to derive the greatest benefit from the electric treatment, it is necessary (1) to put the plant in a position in which there is much more carbonic acid in the air, which can be done perfectly in completely closed greenhouses, and (2) to habituate the plants, perhaps, after a certain number of generations, to a forced alimentation, respiration, and transpiration, and thereby to a much more rapid life. By these means and by judicious electric treatment, it will be possible to urge the production of extreme limits and obtain several crops a year.

As for the source necessary for the electric treatment, M. Guarini mentions the three following ones: (1) Atmospheric electricity. Any of the arrangements employed completely answers the object aimed at. It is necessary to employ atmospheric currents much more elevated than those that have been used up to the present, for the purpose of having high enough differences of potential between the top of the stems and the ground and of having them sufficient to overcome the resistances of the plants and the stratum of air that separates the lower part of the stems of the plants. This layer of air is where there is a production of effluvia and consequently of ozone. (2) Static machines. These M. Guarini rejects for the moment, because they are costly, easily get out of order, and do not produce the intense effects desired. (3) Continuous current and high-tension dynamos. These are cheap and strong apparatus, and, when employed in place of atmospheric currents, it is possible to regulate the electric treatment at will.

On this subject M. Guarini recalls the fact that the Society of the Electric and Mechanical Industries of Geneva has recently constructed a continuous current dynamo capable of generating one ampere at 23,000 volts, and that, by coupling three of these machines in series, it is possible to obtain a 69,000-volt continuous current, which is more than sufficient for electroculture.. Finally, M. Guarini concludes by saying that the life of the plant is an electric phenomenon that can be regulated at will. The agriculturist will no longer be a common laborer, but a skillful electrician, who, like an engineer in his cab, will direct, from his table in the farmhouse, the sprouting and growth of his carrots, potatoes, and cabbages.

* Specially prepared by our Belgian correspondent.

THE RECENT PROGRESS OF TANNING AS A CHEMICAL INDUSTRY.*

By J. T. Wood.

I need scarcely say how much I appreciate the honor you have conferred upon me by electing me chairman of your section. I assure you that it will be my endeavor to merit this honor, and to do all I can to promote the interests of the section. In opening the session I was in some doubt as to what I could say that would be of interest or value. In Plato's "Charmides," Socrates is made to say, "If everybody did what they have the most science of, we should no doubt have everything done most scientifically;" and as I suppose I have more of the science of tanning than anything else, it seems to me better to talk about that, even at the risk of trying your patience, than to venture upon the unknown ground of a general introductory address.

Eight years ago (October 5, 1895) I had the honor to deliver the introductory address to a course of lectures on tanning to the students of the Goldsmiths' Institute, in which I endeavored to set forth some of the advances which this great industry owed to science. The subject of technical education, which I touched upon in my previous address, is too wide to be discussed here to-night. A little knowledge is said to be a dangerous thing, but I would like to say that if a man takes an interest in his work, if he loves it, he must and will want to know all there is to be known about it; whether such knowledge will be of practical use to him depends entirely upon the character of the man, but it is ridiculous to suppose that it can be hurtful to him. I propose to-night briefly to review the progress made during the past eight years, and, perhaps, to indicate the probable course of discovery in the near future. I may say that much of the ground I am about to traverse has been covered by the valuable Cantor Lectures of Prof. H. R. Procter delivered in April and May, 1899, and by his "Leather Industries Laboratory Book" (1898), and quite recently his "Principles of Leather Manufacture" (1903). Only last year two new tanning schools have been opened, one in Turin, through the exertions of Signor Andreis, very completely equipped with machinery and

* Read before the Society of Chemical Industry.

appliances for illustrating known methods or for putting into practice new ideas; the other in Lyons by the Syndicat General de l'Industrie des Cuirs et Peaux.

Taking the operations of tanning in their natural order our knowledge of the preliminary operations has received considerable additions.

Liming.—Payne and Pullman's indirect process (Eng. Pat. 2873; this journal, 1899, 504) is of considerable scientific interest. It consists in chemically producing calcium hydrate in the substance of the skin itself instead of working the skin in lime liquors. The hides or skins are treated with a solution of caustic soda (sp. gr. 1.024) in a drum for three or four hours, and afterward in a solution of calcium chloride (sp. gr. 1.020) for one to two hours. A double decomposition takes place according to the following formula:

$$2NaOH + CaCl_2 = Ca(OH)_2 + 2NaCl,$$

the caustic lime being formed in the fibers of the skin. In this way the same amount of lime is introduced in four to six hours as by the usual method in seven to ten days. It is curious that the process does not loosen the hair of the skin in the same way as ordinary liming unless a certain amount of bacterial action has taken place in the soaks—i. e., if the hide is treated antiseptically the hair remains fast in the skin, and there is no doubt that the absence of bacteriological changes in this process is the chief reason why it has not been adopted for all branches of the trade. The rôle of bacteria in the liming process ought to be studied in our research laboratories in the same systematic way that the bacteria in tan liquors, bates, and drenches have been investigated by Andreasch, Wood, Popp, and Becker. The various species growing in the liquors should be isolated, and their life history and action on skin worked out. In such a way the process of liming as carried out in practice would be thoroughly illuminated. I remember Lord Allerton, then the Right Hon. W. L. Jackson, a thoroughly practical tanner, saying that in his opinion the leather is made before ever it goes into the tan liquors, and in my opinion this applies in an equal degree to liming as to puering.

Bating.—Passing from liming to bating, the action of the dung bate, which is used on almost all light leathers to prepare them for the tanning process proper, has been investigated by the author, and some of the results published (this journal, 1898, 1,010; 1899, 990) under the title of "Notes on the Constitution and Mode of Action of the Dung Bate in Leather Manufacture." In these papers the lines on which a culture of bacteria might be practically applied to the bating of skins were indicated. Such a bacterial bate has now been put upon the market by Dr. Popp and Dr. Becker, of Frankfort-on-Main, under the name of Erodin. These authors have independently investigated the bacteria of dog dung, and have tried the action of pure cultures of over 100 different species on skin. Calf, sheep, and goat skins are now being successfully bated with Erodin on a very large scale.

Pickling Process.—One of the most interesting operations in the course of preparing skins is pickling, in which the raw skins, when ready for tanning, are treated instead in a bath of sulphuric acid and salt. As far as I am aware, this process has been investigated in its scientific aspect by Procter only ("Principles of Leather Manufacture," p. 89; Cantor Lectures, 1899, p. 19), but I believe that a systematic and thorough study of the physical behavior of skin, under the influence of acids and salts, will prove a fertile field of discovery in the future. I might occupy the whole evening with the consideration of this process, but will mention only one instance of its importance in the direction I have indicated. Pickled skin will directly absorb basic chrome salts from a concentrated solution without damage to the fiber of the skin. If chromium sulphate be used it appears to displace the hydrochloric acid on the fibers; this can then be washed out, and the chrome remains fixed in the skin. I may, perhaps, express the hope that some of our research laboratories will take up the study of the process, and publish the results.

Bacteriology of Tan Liquors.—The bacteriology of vegetable tan liquors was thoroughly studied by the late Prof. Andreasch, of Vienna, his work "Gährungs Erscheinungen in Gerbebrühen" (this journal, 1896, 910) being the most important hitherto carried out in this field. He isolated and described a large number of organisms growing in tan liquors, and showed the various changes brought about by them. A few of the more important results of his researches may be briefly summarized. 1. Putrefactive bacteria from the hides, bates, drenches, etc., accommodate themselves to the acidity of tan liquors, they dissolve certain nitrogenous constituents of the hide, and thereby furnish the chief nutriment for the more specific acid-producing bacteria. In liquors which are in use, the production of acid is proportional to the hide substance present. 2. Acetic acid, which in fresh tan liquors is the chief acid, is always formed by two separate processes: (a) the production of alcohol by yeasts from the glucoses of the non-tannins, and (b) the fermentation of the alcohol by acetic bacteria. In tan liquors, acetic acid is never formed directly from carbohydrates. 3. Lactic acid is produced by several species of bacteria both from the sugars and other carbohydrates of tan liquors, and from the sugars alone by a yeast. A good supply of nitrogenous nutriment is necessary for its production, the greater part of which is furnished by the hides. 4. Butyric acid occurs in traces only in sound tan liquors.

Tanning by Concentrated Extracts.—In the tanning process proper the principal change is the large increase in the use of strong extracts, the most important being quebracho. Solid extracts made from this wood contain from 60 to 70 per cent of tannin, and are cheap, the price of the tannin per pound averaging 3d., as against 6d. for the tannin of gambier, and 3.80d. for sumach tannin. It is especially of value for the tannage of light leathers. One of the sources of loss in the use of these solid extracts, viz., the insoluble matter (difficultly soluble tannins), has been done away with by the patent process of Lepetit, Dollfuss, and Gannser (Eng. Pats. 8582 of 1896 and 2603 of 1898; this journal, 1897, 46; 1899, 285), by which the wood is treated with bisulphites of soda. The extracts keep the leather soft, and act more quickly than those prepared in the usual way. Parker and Gannser (this journal, 1901, 1085) have shown that the sodium bisulphite in the extract is not absorbed by the leather, and that no sulphuric acid is formed. I may call attention, however, to the fact that extracts prepared in this way cannot be used to tan pickled skins, owing to the acid decomposing the salts which hold the difficultly soluble tannins in solution. In connection with the vegetable tanning process I would suggest a great problem for our organic chemists, of whom we have some distinguished representatives here to-night—a problem not only of importance to tanners, but of great interest to botanists in the study of the physiology of plants—I mean the synthetic production of tannin on analogous lines to the synthetic production of indigo. This thing is not a manufacturer's business; it is purely a question for the organic chemist. So far back as 1867, gallotannic acid was synthesized by Löwe, by the action of silver nitrate on barium gallate ("Leather Industries Laboratory Book," Procter, p. 60), and it seems to me possible, considering the great advance which has been made in organic chemistry since that date, to produce commercially a pure gallotannic acid. Procter has shown, and I have fully confirmed his conclusions, that leather can be made by means of gallotannic acid, and if this can be produced synthetically I foresee many important uses for leather tanned with it.

Valuable contributions in this department are the Society of Arts Committee's report on Leather for Bookbinding, and Dr. Gordon Parker's paper on the same subject (Jour. Soc. Arts, 50, [2558], 25, 32), in which the causes of decay in bookbindings are clearly specified and remedies pointed out. Parker's paper on the "Application of Kjeldahl's Method of Estimating Nitrogen in the Tanyard as a Means of Controlling the Tanning and Finishing of Sole Leather," is also of value as pointing out to the tanner a way in which he may gain an exact knowledge of the composition of his leather in every stage of the process.

Chrome Tanning and its Chemistry.—In chrome tanning there has been a great advance in the quantity of leather produced; indeed, it has almost displaced the older sorts of leather for the uppers of fine shoes. I do not know of any great discoveries, but a notable contribution to the working of the process is Procter's description of a cheap one-bath chrome liquor (Leather Trades' Review, January 12, 1897; this journal, 1897, 152). Bichromate of potash is reduced by means of glucose and the calculated quantity of acid sufficient to form the required basic salt. Skins are tanned with this liquor as with the one-bath chrome liquor of Martin Dennis. Lepetit, Dollfuss, and Gannser have recently patented a process for tanning and coloring skins in the same bath and at one operation.

In the chemistry of chrome tanning much research has been done, one of the chief points elucidated being the state in which the chromium exists in the skin. In the case of the two-bath process it was supposed that the chromium existed as the oxide, on or in combination with the fiber of the skin. Krutwig and Dalimier (this journal, 1900, 58) found that normal chromium sulphate, $Cr_2(SO_4)_3$, was absorbed by skin in an unchanged condition. The salt used in practice is more basic, and Procter and Griffith have ascertained the relation of chromium to acids both in the leather and in the residual liquors in the one-bath process (this journal, 1900, 225), using a tanning liquor made by adding 25 c.c. of normal sodium carbonate (=1.328 grm. of Na_2CO_3) to 100 c.c. of 10 per cent chrome alum solution. The chrome in this liquor is represented by the formula $Cr_2(SO_4)_{1\cdot5}$. In the leather produced the relation or ratio of chromium and acid corresponded to the formula $Cr_2(SO_4)_{1\cdot21}$, that in the residual liquor to $Cr_2(SO_4)_{2\cdot6}$, showing that the chromium fixed in the leather is more basic than that in the original liquor. This result is not in agreement with Krutwig's (Collegium, 1902, 20—161), who found not only the normal salt, but also a basic salt, $Cr_2O_3 2Cr_2(SO_4)_3 + Aq$, were absorbed unchanged. Fahrion (Coll., 78, 278) considers that both Procter's and Krutwig's conclusions are correct, but that their different results are due to the different ways in which they prepared the skin for tanning.

Stiasny (Der Gerber, 1901, 235; 1902, 121) has shown that in the two-bath process, although hydrochloric acid is used both in chroming and reducing, a basic chrome sulphate is formed on the fiber of the skin. The SO_4 is furnished by the thiosulphate used for reduction, while the Cl is washed out in the form of sodium chloride. He further showed that chromium sulphates possess more powerful tanning properties than the chlorides.

Wünsch (this journal, 1902, 1544) has patented a one-bath tanning process in which a precipitated chromium hydroxide is dissolved in chrome alum solution in such proportions that one-fourth of the whole sulphuric acid is combined with sodium or potassium oxide, and the rest with excess of oxide of chromium. Amend (this journal, 1903, 37) in America has patented the use of nitrates of chromium in combination with alkaline nitrites for tanning, but I have not heard that the process is in use.

Titanium and Formalin Tanning.—Lamb and Spence (Eng. Pat. 11,092, June 30, 1902) have recently patented the use of titanium salts for tanning, these being used in the same way as chrome salts (this journal, 1902, 1286). If I were to enumerate all the patents which have been taken out for chrome tanning I should only weary you to little purpose.

By the advance of chemical industry two other bodies, one of laboratory interest only, have been rendered available for the tanner. I refer to formaldehyde and formic acid. Formaldehyde is sold commercially in the form of a 40 per cent solution under the name of "formalin." It has the property of rendering gelatin insoluble, and several processes have been patented for its use in tanning—Burckhardt, Tullis, Combret, and notably, Payne and Pullman (this journal, 1899, 381; 1900, 915; 1899, 504). The last of these is being worked by Messrs. Pullman, of Godalming, on a large scale in the production of buff leather. The skins or hides are treated in a drum with a mixture of formalin and sodium carbonate; the alkali is subsequently removed by treating the skins in a solution of ammonium sulphate. The leather produced almost exactly resembles chamois leather both in appearance and constitution. Procter (Cantor Lectures, 28) considers the tanning action of fish oils which are used in the dressing of chamois leather to be due to the direct tanning action of aldehydes which are produced by the oxidation of the oil.

Formic acid has given the leather dyer a strong and cheap organic acid, which can be used in place of sulphuric acid, and which has no injurious action on the leather. Lamb, at Herold's Institute, has made a number of careful experiments on the use of this acid, the results of which are published in the Journal of the Society of Dyers and Colorists, September, 1903, and should prove of use to manufacturers. Eight years ago there were people who predicted that aniline dyes would entirely displace the old wood colors. This, however, has not been the case. On the contrary, the wood colors have been given a new lease of life by the introduction, on the one hand, of their extracts in a handy and concentrated form, and, on the other hand, by the application of titanium salts as mordants for these wood extracts. Lamb in England and Dreher in Germany (this journal, 1902, 1286; 1903, 906) have done some valuable work on this subject, and I am able to show you a number of colors dyed with the help of titanium in the dyeing laboratory of Herold's Institute by Mr. M. C. Lamb.

I have already referred to the patented process of Lepetit, Dollfuss, and Gannser, by which skins are dyed and tanned in one bath. This is accomplished by adding to a chrome liquor, dyestuffs which do not precipitate—such as logwood lake, indigo substitute, naphthol black, orange 2 B, naphthol yellow S. The tanning proceeds in the same way as in the one-bath chrome process.

Machinery-Degreasing and Theory of Tanning.—The construction of machinery for leather work has made enormous strides during the past eight years, and although this has nothing to do with chemistry, I cannot let the occasion pass without mentioning a few points. Although the shaving machine invented by Rood in America was in use at the time, it has since almost driven out hand-shaving, and in some cases does work which it was impossible to do by hand. The Vaughan striking-out machine, the principle of which is also applied to unhairing, has been modified and improved by Turner (again in America). He has increased the number of tables to five, and the machine will unhair from 3,000 to 4,000 skins per day with one operator. The striking-out machine, with two operators, will put out 3,000 skins per day.

The degreasing of leather has attained very great importance. The process of extracting the grease from leather by means of benzoline was introduced into this country from the United States in 1878 by Sir John Turney, the head of the firm to which I belong. It consisted in dipping the skins in a vessel filled with benzoline and leaving them until the grease had dissolved out by diffusion; when the solvent became so far saturated with grease as to be of no further use it was run into a still, and the spirit distilled off and used again. The process was expensive on account of the loss of solvent from the skins, which were simply dried in the open air. Mr. F. N. Turney, a brother of Sir John's, after numerous experiments, succeeded in constructing a plant by which the whole of the solvent was completely recovered both from the greasy residue and from the skins. There are now large plants at work in London, Paris, Nottingham, Stourbridge, New York, and elsewhere.

I have no time left for any consideration of the theory of tanning, but it presents problems of great interest to the chemist and physicist. Körner (Jahresb. Deutsch. Gerbersch., 1899, 1900, 1903) has contributed three important papers in which the tanning process is discussed in the light of modern theories of physical chemistry. Körner comes practically to the same conclusions as Knapp did forty-five years ago in his classical research on the nature of tanning, viz., that leather is animal skin in which the fibers are prevented in any way from sticking together on drying. In other words, tanning is a physical and not a chemical process. Körner's conclusions are adversely criticised by Fahrion (Zeits. f. angew. Chem., 1903, 28—29) in another most valuable and instructive paper, in which he endeavors to show that tanning is a chemical process,

and that leather is a salt in which the hide can function either as base or acid. I consider these papers of great importance to the science of tanning, as bringing together varying and apparently conflicting views of the process, and, as it were, crystallizing the scattered knowledge of it. They show, too, the interest that tanning is exciting in the minds of purely scientific workers.

All these things can have only one result—the advancement of the industry to which I am proud to belong.

RACING AUTOMOBILES IN THE 1904 GORDON BENNETT CUP RACE.—I.

By the Paris Correspondent of the SCIENTIFIC AMERICAN.

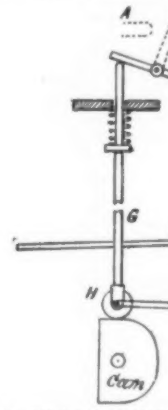
IT will be remembered that the cars which took part in the Gordon Bennett race were as follows: The French team was composed of the three makes, Mors, Georges Richard, and Turcat-Méry. Germany and Austria were each represented by three Mercedes cars. The Belgian racers were built by the Pipe Company, while the English were of the Napier and Wolseley makes. Italy was represented by three cars of the Fiat pattern. It is intended to describe the different cars more or less in detail, and to give some of the principal points of construction, referring especially to the novel features which have contributed to their success.

In the Turcat-Méry car, the motor has a capacity of 80 horse-power. It is mounted on the front of the chassis, directly behind the radiator. The motor is formed of four vertical cylinders mounted on an aluminium crank-case. The cylinders are cast in pairs, and the water-jacket forms one piece with the cylinders. In this type of motor, the cylinder head or cap is formed of a separate piece which is bolted to the main body. The crank case, which holds the cylinders, is built in two parts. The upper part contains two openings for inspecting the inside of the case. The lower part, which is bolted to the upper, is provided with three curved arms on each side, which serve to hold the motor against the side bars of the chassis. These arms are very strong, and the motor is thus rigidly held in place. The crank case contains the crank-shaft, cams, and governor, all well protected against dust.

The motor runs at 1,200 revolutions per minute when at the maximum speed. The cylinder bore is 155 millimeters (6.2 inches) and the stroke 170 (6.8 inches). In the present racing car, the inlet valves of the motor are automatic, while the exhaust valves are operated mechanically according to usual practice. One feature to be noticed here is the design of the inlet valve. In place of a single large valve, the makers now use a set of four small valves about one inch in diameter, which are mounted upon a circular plate 3½ inches in diameter and fitting into the valve chamber. This arrangement has been preferred to a single valve for the inlet. Each of the four small valves is held against its seat by a spring which is fixed in a strap upon the upper side of the plate. The exhaust valve is formed of a single large disk about 3 inches in diameter. Both valves are easily removed from the cylinder by taking off a cap, *M*, which closes the top, as shown in the photograph reproduced below.

The carbureter, *A*, which will be noticed at the side of the motor, is of a new design. It keeps the proportion of gas and air in the explosive mixture always the same, no matter what may be the speed of the motor. The diagram shows a section of the carbureter. It works on the float-feed and atomizer principle. At the right is the float-chamber, *A*, into which the gasoline is fed from the main reservoir by the inlet tube, *B*. The supply of liquid is regulated by the needle-valve *C*, which can be adjusted by the screw, *D*, at the top of the carbureter. The gasoline passes from the float-chamber by the tube, *E*, to the atomizing nozzle, *F*. The mixture of gas and air takes place in the chamber, *G*. The air for this purpose enters from below by the opening, *H*, into the tubular chamber, which contains the end of the atomizer nozzle. The air enters this chamber by two orifices at the top and bottom, and thus a good mixture is secured. The gas then passes to the motor through the pipe, *L*. The supply of gas is regulated by the sliding tube *I*, which acts as a throttle. It is operated from the outside by the lever, *J*. The throttle is controlled by the governor of the motor and serves to regulate the supply of gas according to the speed of the latter.

One of the interesting points to be noted in the Turcat-Mery car is the method of operating the ignition of the cylinders. The variation of the ignition moment with reference to the piston stroke is carried



MAKE-AND-BREAK IGNITER OF TURCAT-MÉRY CAR.

out by a small handle which is mounted on the top of the steering wheel. The steering rod is hollow and a small rod passes down through it from the handle to the side of the motor. By turning the handle (which moves around a notched sector on the top of the wheel) the driver can vary the ignition and at the same time throttle the carbureter. This arrangement will be observed at the side of the motor, where *B* is the lower end of the steering rod. By a suitable transmission, *C*, the rod *D* is made to operate the throttle valve of the carbureter independently of the action of the governor. (The latter operates on the lever *E* on the right.) The same movement acts upon the ignition by means of the horizontal rod, *L*, which passes between the cylinders to the opposite side of the motor.

The method of ignition is shown in the diagram, and part of the details may be also observed on the front view of the motor, at *P*. In the present case the usual method of igniting by spark plug is not employed, but the spark is produced in the interior of the cylinder by a mechanical break device. This will be noticed at *A B* in the diagram, where *A* is an insulated metal piece inside the chamber, and *B* is an arm which is operated from the outside. The break occurs between *A* and *B* by the movement of the arm *B*, which is operated by a cam and push rod. The arm, *B*, is mounted on a horizontal movable stem which projects outside of the cylinder. On this stem is fixed a trip lever, *C*, which holds *B* against *A* by the spring, *D*. There is a second spring on the opposite side of the lever to provide for accidents. The trip, *C*, is operated by the rod, *G*, which passes up from below. On the end of the rod is a roller, *H*, which presses against the semicircular cam. This cam is driven from the crank-shaft. At *N* is a main shaft, which passes along all four cylinders. This rod is connected with the roller, *H*, by means of a lever arm. In this way, by turning the rod, *N*, through a greater or less angle, the roller, *H*, is displaced relative to the cam, and the ignition occurs at a different point with reference to the piston stroke.

Each of the four igniters of the motor has such a device. The four rollers are shifted simultaneously by means of the rod, *L*, previously mentioned, which passes to the front of the motor between the cylinders and is controlled by the driver's handle. In this way a simple movement of the handle serves to shift the ignition point and also acts upon the carbureter. It will be noticed that the device for the spark break is mounted in a compact form on a single plate which can be removed from the side of the cylinder by taking off three bolts. This plate contains the binding post for the wire carrying the current. The mechanism which controls the ignition shifting has been made as simple as possible, and all parts which might be subject to wear or to deterioration from jar or vibration shocks have been suppressed. As the speed of the spark break varies with the motor speed, the advance or retard of the ignition is automatic to a great extent. Magneto ignition is used in the present car.

The radiator is mounted in front of the motor and is formed of a series of tubes which carry radiating fins. This form has been preferred to the honeycomb type after trying the latter, as it was found to give better results in practice, besides being of a more solid construction and not so liable to accident. Should the radiator fail to work, the water will still circulate on the thermo-siphon principle, as the water reservoir has been mounted at a higher level. The water tank will be noticed at *I* behind the motor. The water pump is driven from the motor by chain and sprockets.

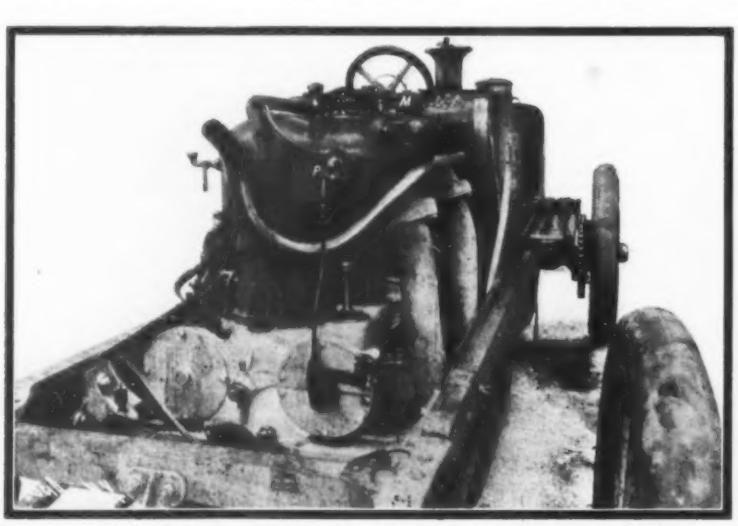
The gasoline tank is mounted in the rear of the car. It contains about 35 gallons. To insure a good supply of gasoline to the motor, the reservoir works under air pressure, and for this purpose the driver has a small air pump at hand. Beside the air pump is a small oil pump for assuring the lubrication of the different working parts.

The chassis is built of pressed steel combined with wood, and is very light and solid. The new cars have a draw bar which serves to stiffen the side beams of the chassis. The wheel base is 9 feet, 1 inch; and the tread is 4 feet, 5 inches. A newly-designed system of ball bearings is used for the wheels, by which the minimum amount of friction is secured. The front wheels are 35.2 inches in diameter, and the rear wheels slightly larger. The brakes, which act upon the rear wheels, are of the internal shoe type. A second brake, which is somewhat similar in design, acts on the differential. It also works inside a cylinder, and the two brake shoes are operated by a rod which is connected to a second pedal.

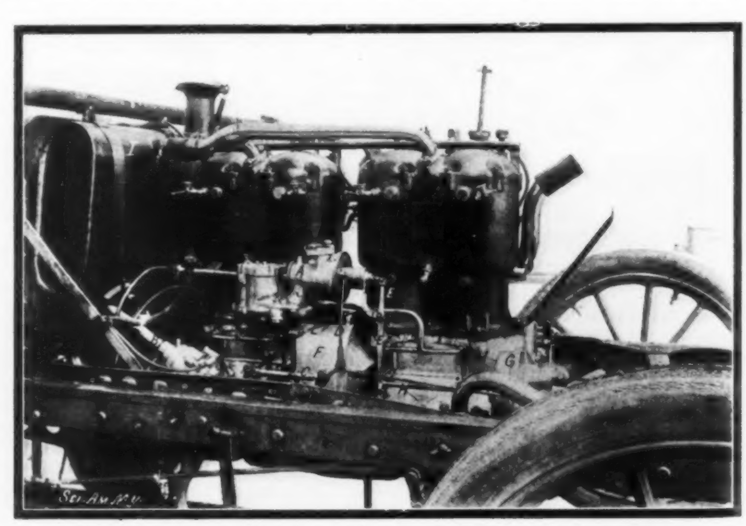
The Italian cars are built by the Fabbrica Italiana di Automobili, of Turin. The engravings show a complete car and also the motor and principal working parts in detail. The motor is rated at 75 horse-power. It is of the four-cylinder type, with the cylinders mounted in pairs. The water jackets are formed of metal plates which are fastened against the outside of the cylinder, and the whole thus presents a hexagonal appearance. The inlet valves are operated mechanically, contrary to the preceding type. For this purpose the valve disposition is different, and all the inlet valves are placed on one side of the motor, with the four exhaust valves on the opposite side. Both sets of valves are operated from a long cam shaft which passes through the crank case and is driven from the main shaft of the motor by gearing. The position of the latter will be noticed in the detail view, and also the magneto for the ignition, which is here placed quite near the front and is driven also by gears.

The Italian cars also use the system of ignition by make-and-break igniter inside the valve chamber. This device is similar on its general lines to that which has just been described, but in the present case the rods which operate the break mechanism pass directly into the crank case, where they are operated by a set of cams upon the same shaft which works the valves. A special disposition is used to give the ignition timing, and the latter is always proportional to the motor speed. The details of this device will be given in a later description. In this motor the contacts for the spark are made of pure nickel, as this is found superior, owing to the fact that it does not oxidize or otherwise deteriorate under the action of the spark.

The radiator, which is mounted on the front of the car, is of the honeycomb type. The water tank is placed in the rear of the chassis. A centrifugal pump,



FRONT VIEW OF TURCAT-MÉRY MOTOR AS MOUNTED ON THE RACING CAR.



SIDE VIEW OF TURCAT-MÉRY EIGHTY HORSE-POWER MOTOR.

driven from the motor, secures a good water circulation. A special pedal, which is placed between the friction-clutch pedal and the pedal for the differential brake, is used to operate the accelerator of the motor. The latter acts upon the governor and increases the admission of gas from the carbureter to the cylinders. A handle mounted upon the steering rod serves to work the accelerator when the motor runs at slow speed. The gasoline tank is placed in the rear of the chassis. It contains about 25 gallons. Like the former, it works under pressure, so as to secure a good delivery of the liquid. The exhaust gases of the motor are taken off through a large pipe which leads to a muffling box in the rear of the chassis.

The weight of this car, when empty, is 2,190 pounds. The wheels are spaced 9 feet, 4 inches apart; and the gage is 6 feet, 2 inches. The front and rear wheels have the same diameter, or 36.4 inches. The speed-changing box is of the usual sliding gear pattern, and provides for four speeds. As in the former case, the use of direct driving from the motor to the rear when at full speed has been abandoned. Chains and sprockets are used to drive the rear axle. The chassis is built of pressed steel. A hand lever is used to throw the brakes upon the rear wheel. The brake upon the differential is worked by a pedal.

The engraving shows one of the cars mounted by Alessandro Cagno, who is one of the chauffeurs of the royal family.

(To be continued.)

PEAT AS A FUEL.*

THE general public in America have but a superficial knowledge of the character and properties of peat, beyond what they have gathered from hearsay, or the testimony of Old Country people in regard to the burning of dried turf, or sods cut from the surface of bogs and marshes. Peat, or turf, is formed by the slow decomposition or carbonization under water of a variety of accumulated vegetable materials. There are two species, one formed from aquatic grasses, the other from mosses.

The peat formed from grasses (or sedges) is dark gray in color on the surface and black below and is nearly destitute of fibers. It flourishes in limestone districts, as it needs lime for its nutriment, and grows so rapidly that mosses cannot live in the same vicinity; when dry it is hard and firm like clay.

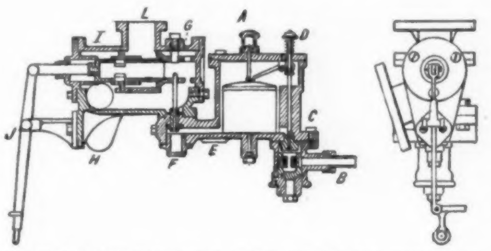
The "sphagnum moss" is reddish-brown in color, fibrous in structure and is generally found in regions where the rocks are granite or silicious and where the surface waters are free from lime, and while the moss or sphagnum flourishes in pure water it grows upward and continually dies away beneath, thus in the course of ages forming beds sometimes 100 feet deep, the average bog, however, being from 5 to 50 feet deep, and is found in abundance in almost every portion of the United States, Alaska, Canada, and the South American republics.

The deposits of Great Britain and Ireland occupy an area of 6,000,000 acres, and much more extensive beds are found in Germany, Russia, Norway, Sweden, Finland, France, and other countries of Europe and Asia.

All European countries have for numberless years used peat in a crude form as fuel for domestic purposes. In Ireland and Germany its use is well nigh universal. The usual mode of preparation is to cut it out of the bog with an iron instrument called a "slane." These bricks are dried in the open air, and are then ready for use. Peat fuel in this form is too bulky to be a commercial success, hence the many and varied experiments to eliminate the moisture and reduce the crude peat mechanically to a product which would assure its use commercially in competition with coal.

are thrown off during the transition in the shape of natural (or marsh) gas.

The tar, paraffin, light and heavy oils, and other volatiles are eliminated by the load of strata over it which escape and form the natural gas belts and petroleum wells of this country. Peat as it goes below the surface naturally takes on the iron which changes its color from brown to black; the sulphur has a vulcanizing effect on the material, hence the hardness of the anthracite over the lignite and bituminous coal; thus peat is embryo coal (or coal is deteriorated peat) which by



CROSS-SECTION AND END VIEW OF TURCAT-MÉRY CARBURETER.

the latest improved patent process is converted almost immediately into coal, retaining all the original heat-bearing properties, and none of the detrimental features of the coal, such as sulphur, phosphorus, and other foreign materials which produce gases so injurious to boiler surfaces. Peat does not contain any slate or foreign substance to form clinker and residuum in the firebox, as is usually found after burning either bituminous or anthracite coal.

Peat being a smokeless steam producer, is superior to all other known fuels, as by its use you get almost perfect combustion. Peat briquettes give a long, bright flame, and intense heat from the moment of ignition, leaving no soot, clinker, or cinder, and very little ash, the combustion being even and complete.

Peat being a gaseous (not a radiant) fuel, requires only half the amount of air (oxygen) to produce perfect combustion; it leaves no clinker to obstruct the flow of the air, and the briquette, being cylindrical in form, permits free passage of air between the pieces; consequently, the grate bars are always clean and the volatile gases are released and come into perfect combustion by the admission of a sufficient amount of oxygen, without lowering the temperature of the fire.

Coal cannot be mined and marketed as cheaply as peat, as peat is on the top of the ground and often in close proximity to our large cities, making long hauls unnecessary by providing a market at the factory site, and enabling the manufacturer to supply the public direct in successful competition with coal.

The economic effects obtained by the use of peat may be grouped as follows:

1. Production of direct results by combustion, warming, cooking, etc.
2. Production of indirect results through steam.
3. Production of indirect results through conversion into gas.

PREVIOUS METHODS AND FAILURES.

For centuries peat has been burned as an article of fuel; in Europe the primitive method of preparing the fuel for use was by cutting it out in square bricks and drying it in the sun, but this fuel was bulky, friable, dusty, crumbled in handling, and required too much room for storage to make it a commercial success, with other fuels in abundance.

The next step looking to the utility of this natural material as fuel was a process whereby the peat was

as no permanency can be given to blocks that have to be dried after formation; the necessary solidity cannot be imparted or maintained to prevent reabsorption of moisture.

Many systems of machinery have been patented for the production of a peat briquette by what is known to the art as the "dry process," which is the forming of the block after the material has been deprived of water (which is usually fifty to seventy-five per cent); there are but three that I consider worthy of your consideration, after making an exhaustive study of every system in use in this country and Europe; they are as follows:

1. A carbonized block of peat. The peat was partially dried and heated, then brought to the point of carbonization between hot rolls and pressed in a hot mold into a dense block. In heating the material, the tar and lighter volatiles were liberated and thrown off, thus reducing the efficiency of the fuel one-third, but producing a block extremely dense, which could be transported without injury.

Suitable machinery for carrying out this process was never built or perfected, owing to the death of the inventor.

2. Some ten years later patents were taken out for the production of a cold pressed peat briquette in reverse to the previous method (or carbonized block) by simply subjecting the peat to heavy compression in a cold mold, relying only upon the glaze imparted to the briquette in the mold for its waterproof qualities.

By compressing the material cold and raw, the full caloric efficiency of the peat briquette was maintained (no volatiles being thrown off by heat), but the result was a briquette loose in texture, which disintegrated with moisture or in the fire, also necessitating the drying of the crude material to the atmospheric degree, which operation was expensive. The briquette also required an extreme degree of compression, as there was no bond used.

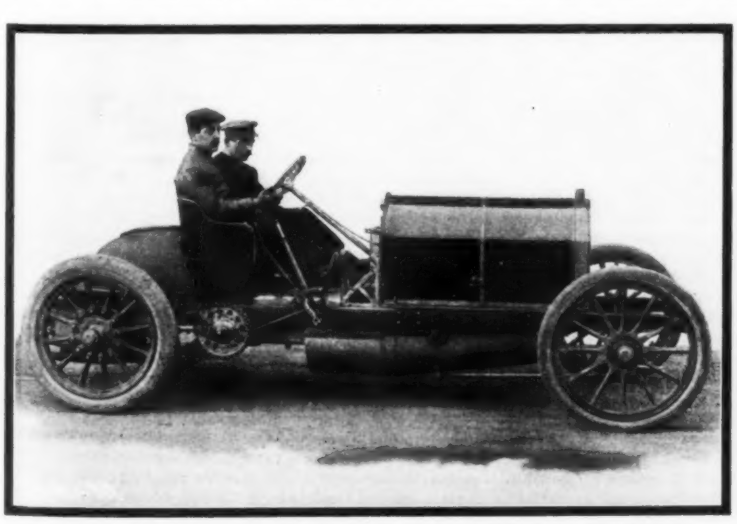
While this style of peat briquettes is an efficient steam producer and a smokeless fuel, it has to be transported in box cars and kept in dry places to keep it from reabsorbing moisture and disintegrating.

3. The third system of patented machinery is for the production of what is known to the art as a "seared" peat briquette.

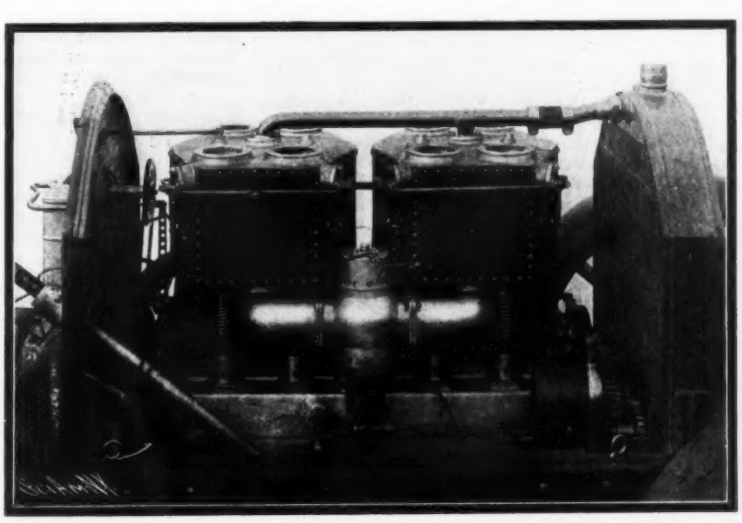
The "seared" block embodies every feature of value found in either or both of the above-named systems, is more economical in production than either, or any other form of pressed peat known to me. While it contains far more combustible matter than the first named, or carbonized block, it is free from the serious objections of the plain, dry pressed block, which possesses no waterproof quality whatever, and is friable to such an extent as to unfit it for favorable consideration in any market.

The "seared" block burns completely, gives an intense heat from the moment of ignition, is absolutely free from sulphur, has no clinker, soot, smoke, or ash, ignites easily, is easy to regulate, and with no danger of asphyxiation, it being recommended by the highest medical authorities as a fuel for its hygienic advantages.

Professor Carpenter gives the caloric value of the best grades of Scranton (Pa.) anthracite as 13,805 B. T. U. against 13,330 in peat briquettes (according to the German chemical testing station of Berlin), while Prof. C. L. Norton, chief of the Experiment Station of the State of Massachusetts and Institute of Technology, Boston, says that, with the proper preparation and mechanical pressure, peat will average 12,000 to 14,000 heat units to the pound and equal anthracite coal as a heat producer; and while analyses show a much higher ratio of fixed carbon in coal than in peat, there is one important element that must be taken into considera-



SEVENTY-FIVE HORSE-POWER FIAT GORDON BENNETT CUP RACER.



FRONT END OF FIAT RACER, SHOWING ENGINE, CARBURETER, MAGNETO, ETC.

Peat is the first stage in the formation of coal. Beginning with peat we pass to lignite (or brown coal), then to bituminous coal, and finally anthracite coal. In passing from the vegetable to the mineral state a large percentage of heat-bearing properties of the peat

* Extracts from a paper by J. Campbell Morrison, C. E., read before the Robert Fulton Association of the National Association of Engineers.

ground to a plastic mass, or formed in brick shapes, dried in the open air, or in a kiln, till it became hard; but the product was a fissured block, the volatiles being liberated in the drying, and the block continuing to crack to such an extent as to unfit it for transportation.

Many patents have been taken out in this country and Europe for machinery to properly consolidate peat while wet, but they have all been comparative failures,

tion in actual boiler practice, viz., the volatiles in the peat briquettes; for while the fixed carbon in peat only runs 27 per cent to 35 per cent, the volatiles run from 56.20 per cent to 65.09 per cent, resulting in a high degree of temperature being maintained in the fire by the volatiles coming into combustion, and consequently the perfect combustion of the hydrocarbons. Many authorities quote peat as a low grade fuel on account

of the small amount of carbon shown by analysis, but in actual boiler tests made by myself I have proved the contrary.

PROCESS.

The following is an outline of their process for the manufacture of the "seared" briquette:

The peat is dug from the ground by the excavating machine, which is very simple in construction and moves forward under its own power, propelled by a gasoline motor, where it is discharged onto a conveyor and carried to the expelling machine, where a preponderance of the moisture is thrown out by a patent automatic expeller.

In wet ground where it is impossible to work the excavator, the material is taken out with a sand pump by suction.

From the expeller it proceeds to the disintegrator, where it is pulverized and passes on to the drier, which is a round cylinder 5 feet in diameter and 30 feet long, revolving on axles located at each end. Under this is a furnace, where heat is generated and applied to the exterior of the cylinder, the hot gases traveling the entire length and back through the interior of the cylinder to the point where the material is delivered.

At this end there is located an inverted fan, which sucks the wet vapors from the material and at the same time tends to draw the heated gases through the material. As the cylinder is set on an incline, the dried material passes through by gravity and is discharged at the lower end, with about 20 per cent of moisture.

It is then conveyed to the breaking machine, where it is pulverized to a powder and elevated to the hopper bin above the presses. In passing through the presses, the peat is first pressed into hard, dense blocks and afterward "seared" by liberating the tar and paraffin in the material by heat, thereby coating the exterior with a waterproof coating, making it impervious to moisture and spontaneous combustion.

The result of this process is to produce a smooth, oily and dense texture externally, so as to present the most inflammable constituents of the peat to the immediate action of the fire when igniting, to increase the hardness and water-resisting qualities of the manufactured fuel, and while not depriving the raw material of any really valuable combustible constituents (for an extreme preponderance of the lighter volatiles only tends to unduly hasten the consumption), to render the block more lasting in the fire, and, consequently, more approaching to hard coal in value for steam raising, domestic, and other purposes where the maximum of the heat is to be produced with the minimum feed and replenishment of fuel.

Thus it will be seen that this process contemplates a continuous operation from the time the material is excavated from the ground till it is turned out by the presses a finished, marketable product.

All material used for generating steam and operating the different machines is furnished from the refuse or waste peat about the plant, and no skilled labor is required, with the exception of the engineer in charge of the engine room; thus the production of peat fuel by this improved method, in my opinion, solves the problem of furnishing a cheap, clean, uniform and reliable fuel for domestic and manufacturing purposes.

It is equally serviceable for grates, stoves, cooking ranges, boilers, and furnaces, giving a long bright flame and intense heat from the moment of ignition, and its durability is equal to coal in combustion, as the density of the "seared" block insures the retention of its original form until the last atom of the inherent carbon and volatile gas have been consumed.

The combustion is so thorough and complete that no volume of free carbon or deleterious vapor is allowed to escape, hence its hygienic and economic value over hard and soft coal. It will not absorb any undue amount of moisture or otherwise deteriorate in storage, is odorless, and clean to handle.

A company has secured the exclusive patents on the machinery and process for the production of a "seared" peat block and is at present constructing the machinery for the first plant to be erected in the State of Illinois, and it gives me pleasure to state that in the near future we may look forward to the end of the smoke nuisance and the dirt of coal firing, and I know that all engineers and firemen will gladly welcome the introduction of a clean, smokeless steaming fuel.

Before closing, I wish to state for the information of the gentlemen present that Russia produces annually 4,000,000 tons of peat fuel-briquettes and receives $938,000 per annum for the leasing of the peat bogs. Germany produces 2,000,000, and Holland and Sweden each 1,000,000 tons of this fuel. Thus it will be seen that peat fuel-briquettes have passed the experimental stage, and the subject is one of sufficient importance to command the most earnest attention of the business man and manufacturer, on account of its application to domestic purposes, manufacturing and the arts.

In compiling the data of this paper, aside from the information gained by personal experience and observation covering some three and a half years, I have quoted freely from several writers of ability so that the facts presented are absolutely correct.

Paint and Varnish Remover.—

Caustic soda (98 per cent)	1 pound
Starch	2 ounces
China clay	2 ounces
Warm water	2 pounds
Cold water	2 pounds

Dissolve the soda in the warm water, and stir the starch and clay well together adding the cold water a little at a time until all is used. When the soda solution gets cold, add it to the other mixture, and stir to a smooth paste.

This is used by applying to the paint and allowing it to remain for a few minutes, when paste and paint may be removed with a scraper or old brush. The wood should then be washed with clean water, and if that does not remove the soapy feel (or taste), another washing with water and vinegar should be given.

SCIENCE NOTES.

To inoculate sterile ground and make it bring forth fruit in abundance is one of the latest achievements of American science. Some of man's most dread diseases—smallpox, diphtheria, plague, rabies—have been vanquished by inoculation, and now inoculation is to cure soil that has been worn out and make it fertile and productive again. The germs that bring fertility are mailed by the Department of Agriculture in a small package like a yeast cake. The cake contains millions of dried germs. The farmer who receives the cake drops it into a barrel of clean water; the germs are revived and soon turn the water to a milky white. Seeds of clover, peas, alfalfa, or other leguminous plants that are then soaked in this milky preparation are endowed with marvelous strength. Land on which, for instance, the farmer with constant toil had obtained alfalfa only a few inches high, when planted with these inoculated seeds will produce alfalfa several feet high and so rich that the farmer does not recognize his crop.—Gilbert H. Grosvenor in the National Geographic Magazine.

In order that the London Board of Trade may know with absolute accuracy what a yard is, a new imperial yard standard has been in course of manufacture for six years past, and it is not completed yet. The new bar is composed of two most valuable metals, platinum and iridium, in the percentage of 90 and 10 respectively. It is being prepared in order to mark the true length of the imperial standard yard at the temperature of 62 deg. Fahr., and has now had its graduations and microscopic lines marked thereon by Dr. J. René Benoit, the director of the International Bureau of Weights and Measures, Paris. The bar was first supplied by Messrs. Johnson, Matthey & Co., of London, in 1897, and subsequently forwarded to the Society for the Construction of Instruments of Precision at Geneva (Société Génévoise) to be finally adjusted, planed, and polished. The bar was then transmitted from Geneva to Paris, where its graduation and preliminary verification was carried out. It was delivered at the Standards Department in March last, having been brought at the instance of the British government and by the intervention of the French authorities from the Bureau International des Poids et Mesures in its box unopened until its delivery at the Standards Department. In a report issued recently by the Board of Trade it is stated that the final verification of this new primary standard measure—which is already six years old, and has seen much traveling—is now proceeding by comparison with the imperial standard yard deposited with the Board of Trade, and with Parliamentary copies of that standard deposited at the Royal Mint and with the Royal Society.

A. Colani finds that the double chloride of uranium and sodium, NaCl UCl_4, is better suited for manipulation than uranous chloride, UCl_4, since it is a stable and but slightly hygroscopic salt. By heating this double salt between 500 and 1,000 deg. C. in a current of sulphureted hydrogen, the sulphide, US, is readily obtained in large delicate square tables. Since US is readily decomposed by water at a red heat, care must be taken that the sulphureted hydrogen be perfectly dry. The same sulphide is obtained on fusing together sodium uranium chloride and an alkaline monosulphide. Uranium selenide, USe, results in extremely slender crystals when selenureted hydrogen is substituted for hydrogen sulphide. If the compound has been prepared at too low a temperature it is pyrophoric. The telluride, UTe, is obtained by passing the vapor of tellurium in a current of hydrogen over sodium-uranium chloride heated to 1,000 deg. C. It forms large, very brilliant scales. Better results are obtained by fusing the double salt with sodium telluride, when black quadratic tables of UTe with a brilliant metallic luster are obtained. Uranium nitride, U_3N_4, which has been previously obtained, is easily formed by heating sodium uranium chloride in gaseous ammonia. After dissolving out the sodium chloride the nitride remains as a crystalline powder of metallic aspect. Uranium phosphide, U_3P_4, does not readily form on heating $NaClUCl_4$ in PH_3; but by fusing the double salt with aluminium phosphide in a current of hydrogen and treating the fused mass with water, dilute HCl, or ether, it is obtained slightly contaminated with alumina, as a black crystalline powder. Uranium arsenide, U_3As_4, in well-formed square tablets, results from the action of H_3As on $NaClUCl_4$; by fusion with sodium arsenide it forms as a crystalline powder. The antimonide, U_3Sb_4, has not been obtained. By fusing the double salt in excess with antimony and aluminium, a white alloy is obtained, which when fused in a Leclerc's furnace in a current of hydrogen, parts with a portion of its antimony, without, however, attaining the formula U_3Sb_4. These compounds of uranium with the metalloids burn with difficulty in the air, but they give brilliant sparks when thrown into the flame of a Bunsen burner. They are violently attacked by strong nitric acid.—Comp. Rend., 137, 382.

ELECTRICAL NOTES.

Recently Sir Oliver Lodge gave at the Institute of Architects, to the members of the Lightning Research Committee and some others interested in the subject, a practical demonstration of the action of lightning, more especially as regarded lightning conductors. The electrically charged cloud was represented by a thin sheet of metal mounted on non-conducting standards charged from a battery at pleasure, and placed in a position sloping downward from front to back, so that the model lightning conductors could have their points brought nearer to or further from the under surface of the "cloud" by shifting their positions on the table. Some of Sir Oliver's conclusions were much at variance with what are popularly accepted. He placed in operation successively conductors of three different substances—copper, iron, and wet string. The copper was the most intense and rapid conductor, producing a sharp crack at the flash; the iron took it with less noise; the wet string with hardly any, yet it was efficient in protecting the two other conductors. Wet string is of course impossible in practice (the thunder shower performs some of its function, however, in relieving pressure), but Sir Oliver maintained that iron was quite as efficient a conductor as copper—and more, that the intensity of action of copper was more likely than iron to set up sideflash, which, in protected buildings, has been the origin of most lightning accidents. Sir Oliver also illustrated and described his classification of lightning into two kinds, which he called "A-flash" and "B-flash." The former was the normal discharge of lightning from an overcharged cloud direct to earth; the B-flash occurred when a large cloud discharged into a smaller one, generally though not necessarily below it, which was over-charged suddenly and discharged to earth with great violence. Sir Oliver Lodge proceeded to show, by several illustrations, why the B-flash might be expected to be more sudden and intense than the A-flash, and proportionately more difficult to protect against, though he would not say that all lightning injuries had resulted from B-flashes. The practical outcome of the demonstration was that a building should have as many points of protection as possible, and that (if we accept Sir Oliver's teaching) the copper lightning conductor is dismissed with costs.—The Builder.

Considering the probabilities of future development of electric transmission, it is reasonable to expect that the utilization of water powers will continue until practically all of any considerable magnitude are put to work. The ability to employ higher potentials means ability to span greater distances, and thus markets will be found for water powers which hitherto have been deemed too remote from industrial markets for profitable utilization. Improved reliability and gradually lessening cost of apparatus will co-operate influentially toward this result, as well also the decrease in rate of interest upon capital which has been so marked in recent years. It is to be expected also that power plants using steam or gas engines to drive dynamos and distribute power electrically over large districts will be constructed. Recently in Great Britain a number of corporations have been chartered with this object in view. Some of these plants are now under construction, and the commercial results of their operation will be of great interest. So far as I am aware, nothing of this kind on a large scale has been attempted up to the present time in America; but there are undoubtedly districts where such enterprises should be profitable. The opportunity for profit rests chiefly upon three facts: (1) that power can be produced more economically by a very large steam plant than by a small one; (2) that the aggregate power which a central station plant, supplying a certain district, is called upon to develop at any given time is very much less than the sum of the maximum outputs of the small plants required to do the same work; and (3) that an electric motor occupies much less space and requires less attention than a steam plant. A 50,000-horse-power steam plant, supplying electric power for general purposes to a district having a radius of fifty miles, will burn about 3 pounds of coal per average kilowatt-hour delivered throughout the district, while the average consumption of coal by the steam plants which such a central power plant would displace is usually not less than 10 pounds per kilowatt-hour. As regards ratio of the maximum output of the central station to the sum of the maximum outputs of the displaced small plants, definite generalization is impossible, because everything will depend upon the kind of work done by the small plants. I think it safe, however, to say that this ratio will rarely, if ever, be higher than 2 to 3, and in some instances which have come under my observation it is as low as 1 to 3. In other words, a 50,000-horse-power central station plant will rarely, if ever, fail to do the work of small plants aggregating 75,000 horse-power, and in some instances will be capable of doing the work of small plants aggregating 150,000 horse-power. Transmission of power from coal fields to large cities works out much less favorably, since in this case it must compete with the alternative plan of transporting the coal to the city or to a point near it and there generating electric power in a steam plant equally economical and equally deriving the benefit which results from the fact that a single large plant can displace a large number of small plants whose aggregate output considerably exceeds its own. In this case, the plant located at a distance from the city must be larger by an amount equivalent to the maximum losses in transmission.—L. B. Stillwell in Cassier's Magazine.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Opportunities for American Trade in Austria.*—I have no doubt that a good market could be created in Austria for any improvements in the somewhat antiquated office furniture and office systems and devices generally in use. This is particularly so for this part of Austria (Bohemia), which offers an almost virgin market for modern American office furniture, systems, and devices, a market which could be made most profitable to the pioneer exporters, but which necessitates strenuous activity and a wise campaign of education on the advantage of our labor-saving office devices.

From personal investigations I must say that, however antiquated the office furniture and systems in use, they enjoy vast and solid popularity, all business and professional men being greatly attached to them, and a serious though comparatively inexpensive campaign is necessary to replace them by American office devices.

American manufacturers have in the past relied too much upon advertising in the United States. American newspapers, trade papers, magazines, etc., are not circulated in Austria, and manufacturers should take it for granted that their office devices are unknown in this country, as well as in other parts of Europe.

American manufacturers have also relied too much on local European agents for the introduction of their merchandise. These agents not only lack knowledge regarding the fortes of American office devices, but are also the agents of other concerns—American and foreign. Their efforts are thus crippled by both lack of knowledge concerning the special qualities of American devices and the necessary division of efforts to satisfy the numerous firms they represent.

If you desire to enter into foreign markets on a large scale, I would advise you to personally introduce your special line of office devices. An A1 American agent, or drummer, speaking the language of the country and introducing only a special line, could do twice the business of any general agent, who would require either a large commission or a substantial salary and devote only a fraction of his time—supplemented by an iota of his energy—to the introduction of your goods.

If such is your intention—entering foreign markets on a large scale—I would also advise you to advertise extensively. Advertising is inexpensive in Austria, especially in Bohemia, and though the newspapers have a small circulation compared to our large American dailies, the advertisements have a large value, as they are generally looked for and read with a certain eagerness and relish.

If you desire to introduce your merchandise directly—that is, selling it directly and by correspondence to the wholesalers and retailers—it is absolutely necessary that your correspondence, pamphlets, and circulars be in the language and currency of the country. It is as unwise for an American firm to try to do business in Austria with English letters, pamphlets, and circulars, with prices in dollars and cents, as for an Austrian firm to attempt the introduction of its wares into the United States with German circulars, pamphlets, and letters, giving its prices in kronen and hellers. This applies also to weights and measures.

I take pleasure in inclosing a list of the few furniture dealers and stationers selling office devices in Prague. I also beg to supplement this with the following pointers:

1. Have your correspondence, pamphlets, circulars, etc., in the language of the country to which you desire to export. Your prices should also be in the currency of the country.

2. If sold direct to the consumer your specialty should be advertised in the local newspapers, magazines, and trade papers. If sold to the wholesalers and retailers, at least advertise in the trade papers.

3. Quote net prices—i. e., have your quotations include freight, transportation, and insurance charges, and in the currency of the foreign country. Quotations c. i. f. are the most practical for the retailers and consumers. For the wholesalers both c. i. f. and f. o. b. quotations could be used.

4. Personal contact with the buyer yields the most satisfactory results. If possible, send an experienced American representative to introduce your specialty. He must, however, be conversant with the language of the country and, if possible, with some other languages of Europe—e. g., French, which is spoken in nearly all important stores and wholesale houses.

5. Call upon United States consular officers for detailed information re the markets you desire to invade. United States consular officers should be in a position to give you the address of wholesalers and retailers, the particular condition of the local market, costs of freight, terms of sale, etc. I would also advise you, as your special device takes but little room and could be used, to place samples of your merchandise at the principal United States consulates, where they could be inspected by possible buyers. Price lists, pamphlets, catalogues, etc., should also be filed at United States consulates.

The following list contains the names and addresses of some of the principal office-furniture dealers and wholesale stationers in Prague, Bohemia, Austria-Hungary:

Office Furniture Dealers.—Glokowski & Co., 17 Graben; Matt C. Steiner, 7 Heinichsgasse; Joseph Svestka, 24 Rosengasse.

Wholesale Stationers.—Ignaz Tushs, 971 Melantrichgasse; A. Hause, 211 Annahof; T. B. Batovec, 852 Graben; Franz Balatka, 16 Graben; Belsky & Jeschek, 2 Wenzelsplatz; Slavik & Löbl, 234 Wachholdagasse.—Urbain J. Ledoux, Consul at Prague, Austria.

* This report was prepared in reply to an inquiry made by a furniture manufacturer of Iowa.

Development of American Trade in Mexico.—If American manufacturers are desirous of obtaining trade in Mexico they should send salesmen capable of speaking the Spanish language and willing to devote themselves to a study of the methods employed by native merchants.

Mexican Mercantile Methods.—As a rule, houses here deal with commission houses in New York or other cities in the United States, to which they consign their shipments of hides, deerskins, vanilla, honey, wax, cedar, mahogany, chile, allspice, sarsaparilla, etc. Against these they draw for 50 or 75 per cent of the value of their bills of lading, according to the nature of the merchandise or the arrangements which may have been entered into between the shipper and commission house. Buyers in good standing and credit place their orders wholly through the commission houses to which they ship their products, usually obtaining sixty to ninety days' credit; rarely six months. In the past this has been one of the serious obstacles to business encountered by such American manufacturers and firms as objected to the long credits usually granted by European houses. To a certain extent the trade in certain lines of goods here has been monopolized by European houses simply because of their willingness to give long credits.

American manufacturers will have to make concessions or sell similar articles at prices low enough to meet European competition. Recently, American firms, finding they could open up branches in this Republic, have engaged in different lines of trade and have thereby avoided high duties and other expenses. This has enabled them to effectually checkmate European competition. One among the various reasons why Americans do not obtain a better footing in this country is that they are indifferent about conforming to the native ideas of packing. They frequently object to putting up goods in packages and boxes of the sizes, weight, and thickness required. If they did it would enable the merchant here to pay the minimum duty, which, according to the Mexican tariff and nature of the article, is assessed by weight, including the inner and outer packages in which they are inclosed. It is therefore evident that boxes and all packages should be made as light as may be consistent with the safe carriage of the articles.

Manufacturers should be willing to comply with any reasonable request buyers may make in regard to the packing and other details of goods ordered, as in this manner they can avoid payment of excessive duty charges, and failing to gratify this requirement they simply jeopardize their own interests and permit European manufacturers to step in and monopolize Mexican trade.

Agricultural Implements.—Manufacturers of and dealers in agricultural implements would serve their own interests best if they would conform to the requirements of farmers in this country. It may be impossible for them to cater to each individual taste or desire; still, it must be borne in mind that it is a poor argument for them to offer their wares on the "take-or-leave" plan.

Mexicans are, as a rule, extremely sensitive, and, while usually desirous of adopting modern ideas and implements, they are, like all the rest of mankind, loath to admit their ignorance, although glad to learn if a little patience and regard for their feelings are displayed by those who desire to do business with them. There is an immense field for all modern agricultural appliances in Mexico, if properly introduced by competent and painstaking persons who speak the language, and who are willing to patiently and persistently try to overcome prejudices which have existed for centuries. Such persons will in time be more than amply repaid for their trouble by securing an immense demand for their products.—A. J. Lespinasse, Consul at Tuxpam, Mexico.

Bread Prices and the War in the East.—The Dutch newspaper Handelsblad of the 24th of February, 1904, contains the following, which may be of interest to American farmers and grain dealers:

"Of much importance is the fact that there is every chance that the war between Russia and Japan and the strained relations of the world in general will cause bread prices to rise in this country. This is a natural result of rising grain and flour prices. For the first few days after the war commenced the cereal trade was but little affected, but lately, with the vague rumors of strained relations between France and England, a tendency of grain prices to rise is noticed everywhere. America has for some time shown a firm market. On January 4 last, 'May delivery' was quoted at 89¾ cents; on February 1 the price had already risen to 92¾ cents; and yesterday (February 23) the price was $1.03½. Wheat, which has been sold at 206 florins ($82.40) per last (85.2 bushels), could six months ago not be disposed of for 186 florins ($74.40), and the Baltic wheat quoted yesterday at 210 florins ($84) could on January 25 last not find purchasers for 205 florins ($82). Flour prices are rising accordingly. All this is not the result of a shortness of the supply on hand in Russia, but owing to the fact that the supply now in Russian ports is all that can be had, as the Russian government has seized all freight cars and new supplies can therefore not be readily transported to the ports. La Plata, where the last crop was abundant, has to be largely depended upon for supplies. If conditions remain as they are, a rise in bread prices may be expected.

"Quotations for oats are also enhanced, as Russia purchases for its armies whatever it can get. The Netherlands raises an enormous crop of oats, but the thick, heavy grain of our fat lands is more suitable for carriage and saddle horses; much of the oats is always exported. The thinner-grained oats for feeding working horses, etc., must be imported in large quantities, and these imports are strongly decreasing at present."—S. Listoe, Consul-General at Rotterdam, Netherlands.

Importations of Wool at Marseilles.—The importations of wool into this market increased during the year 1903 by about 25,000 bales over the importations of the preceding year. Prices have ranged higher, the rise varying from 20 to 30 per cent over the year 1902, according to classification, the increase being attributed by local dealers to the decreased clips at all the original markets of the world. They estimate this shortage at 25 per cent of the average and consider the increase in prices fully justified and likely to continue, if not to advance, during the present year. Local protests multiply against the American custom house distinction between Bagdad and Mosul wools, which frequently have the same intrinsic qualities. The prices at present quoted upon the various wools being exported to the United States fluctuate above and below the maximum figure, which enables entry of these wools at the lowest rate of duty. The following figures give the importations of wool entered for consumption or received in transit at this port:

Importations.

Country.	1902. Entered.	1902. In transit.	1903. Entered.	1903. In transit.
	Bales.	Bales.	Bales.	Bales.
Bagdad, Mosul, and Caramach	10,635	262	16,110	180
Algeria	5,724	1,530	12,211	978
Morocco	7,925	3,206	11,470	936
Australia	......	32,950	......	43,718
Miscellaneous	21,559	17,390	27,385	13,582
Total	45,843	55,337	67,176	59,194
				Bales.
Total for the year 1902				101,180
Total for the year 1903				126,370

—Robert P. Skinner, Consul-General at Marseilles, France.

German vs. American Tool-Machinery.—Tool-machinery prices have not recovered from the pressure of surplus offers, so that factories have been run, not only without profit, but in many instances at a loss, although they have been somewhat busier of late. Prices have not gone up because large stocks of machines are still on hand, and American competition is keenly felt, owing to the fact that, as is claimed, the United States is placing its surplus output of tool machines upon foreign markets.

The Russian-Japanese war does not appear to have affected the manufacture of tool machinery, except that it has brought some orders for war purposes from Japan.

While the matter of forming a combination is still being discussed among tool-machine manufacturers for a better unity of action, no definite steps have been taken.

The trade balance for tool machinery decreased nearly 1,100 tons in 1903, of which 600 tons were due to a decreased export and the other 500 to the increased import of American tool machines.

For the first quarter of 1904 the import increased from 576 tons to 1,070 tons; that is, to a considerably greater extent than the exports, which increased from 5,555 tons to 6,279 tons. This is about six times the amount of the imports, while last year the exports were nine times as much as the imports.

The imports from the United States have more than doubled during the first three months of 1904, being 578 tons, against 269 tons in 1903; appearances tend toward a still higher increase. This seems to be the chief reason for the continued agitation of German tool-machine factories for higher rates of duty.—Joseph J. Langer, Consul at Solingen, Germany.

Winding of Spiral Springs.—The wire is stretched (not too tightly) between two small wooden blocks in a vise, leaving one end projecting. A pin is provided with a hole to receive the wire, the other end of the pin being fixed in a crank-brace. The end of the wire is now inserted into the hole in the pin and turned with the crank. After a few revolutions the coil is slightly pressed into the wood and will take the proper direction by itself. Very regular spiral springs can be made in this way, according to an article in the Techniker, and there is no danger of having the hand wounded by a splinter or sustaining an injury to the finger on account of the wire breaking, an accident which often occurs when the wire is coiled in a lathe.—Der Metallarbeiter.

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Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

ENGINEERING NOTES.

The disaster which occurred in the Paris "underground" less than a year ago has proved a costly matter for the Metropolitan Company, lessee of the line. Compensation cost close upon $235,000 and loss of traffic amounted to over $160,000. The total income of the railway for the year was $3,530,000, and of this, under the terms of the concession granted by the Paris municipality, there has had to be handed over to the relief of the city rates the sum of $1,140,000. Then after deducting the working expenses, which were in the neighborhood of $1,500,000 (forty-two per cent of the receipts), it was possible to give a dividend of about six per cent. The year has been one of great moment to the Paris Company in the matter of capital expenditure upon the new power station, the conversion of the system of electrically working the trams to multiple unit, etc., and a great deal of new rolling stock is now in course of building. The lighting and traction supplies are now effected by entirely separate circuits, so that in future the stoppage of a train through failure of the power circuit will not mean that there will be no light available—a matter which it will be remembered was one of the chief causes of the panic at Paris. The undertaking so far completed represents about twenty-two miles out of the twenty-six miles which constitute the first section. The new generating station, which is now almost ready, has a plant of about 20,000 horse-power.—Boston Transcript.

Making machinery foundations elastic so as to minimize or even altogether prevent vibration of buildings, is a recently much-mentioned subject, special reference having been made to the uses of a particular new kind of impregnated foundation felt which is claimed to have given very satisfactory results. It has been spoken of as intended chiefly for insertion beneath rails, girders and machine beds, and as being made in sheets of varying thickness—from ⅜ inch to 1½ inches. The felt is impregnated with mineral fat, so as to be moisture-proof. In Germany it is said to be in extensive use in connection with steam hammers, pumps, steam engines, and much other machinery; under bridge girders, railway ties, rail chairs, and car bodies; and between columns and joists in buildings, and on shipboard to separate machinery from steel decks and bulkheads. The sheets are made in different sizes up to 60 inches in length by 30 inches in width. Felt mats have for many years been used in anti-vibration expedients, so that there is ample reason to expect satisfaction from the employment of the so-called "foundation felt" here noted; but it may not be amiss to observe that in many instances the apparent desirability of its use is indicative simply of something wrong in the machinery installation. Small earthquakes from the operation of a steam hammer, and trembling buildings from fast-running machinery, often are proofs that the machinery has not been properly put in. Foundations rightly proportioned and rightly laid would materially restrict the market for special foundation preparations and confine their use to the underlaying of rail chairs, bridge girders, and such other more appropriate things as have already been mentioned in the above remarks. With these their services would seem to have a fitness entirely lacking where moving machinery is concerned.—Cassier's Magazine.

A large proportion of the steel work required for the great bridge proposed to be thrown across the Zambesi at Victoria Falls has now arrived. The erection of the bridge is under the superintendence of Mr. Imbault, the representative of the Cleveland Iron Works. The excavations are now being made for the foundations of the stone supports on either bank and the central pier. An island some 80 feet from the northern bank offers a convenient spot for this central support, and the bridge is thus in two spans, the large one being nearly 4,000 feet long. The height will be tremendous—460 feet from the underside of the bridge to the water-level. A wire tramway has been thrown across the river, by means of which materials and men can be transported; and a little later on locomotives will be passed across in sections and put together on the other side, so as to be used in continuing the line to Broken Hill. This is necessary, as the bridge itself will not be ready until December, and, perhaps, even for some months later. Between Bulawayo and Victoria Falls, after the Gwaar, which is not far from Bulawayo, has been passed, there are only two important bridges until the Zambesi is reached. These are a bridge over the Latetsi, and another over the Deka, about 30 miles from each other, and about halfway between Wankies and the Falls. Each of these bridges is some 320 feet in length. The line is now opened for traffic between Bulawayo and the Falls, a distance of 212 miles. Extensive use is being made of coal from Wankies, and the experience acquired in connection with it has confirmed the good impression which was formed at first. Wankies coal is now used exclusively upon Rhodesian railways, and the experience of the Cape government railways also shows that it is, if possible, slightly superior to the best Welsh coal in respect of its heating capacity. The price of Wankies coal at the pit's mouth is 15s. per ton, and the railway rate of ½d. per ton per mile makes its cost at Bulawayo 32s. per ton. The Rhodesian gold mines are beginning to use Wankies coal, and the Bulawayo Water Works and Electric Lighting Company have also discarded wood in its favor. The output of Wankies coal has now reached a total of 10,000 tons per month, and a large increase is anticipated in the production.—Engineering.

THE

Scientific American Supplement.

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